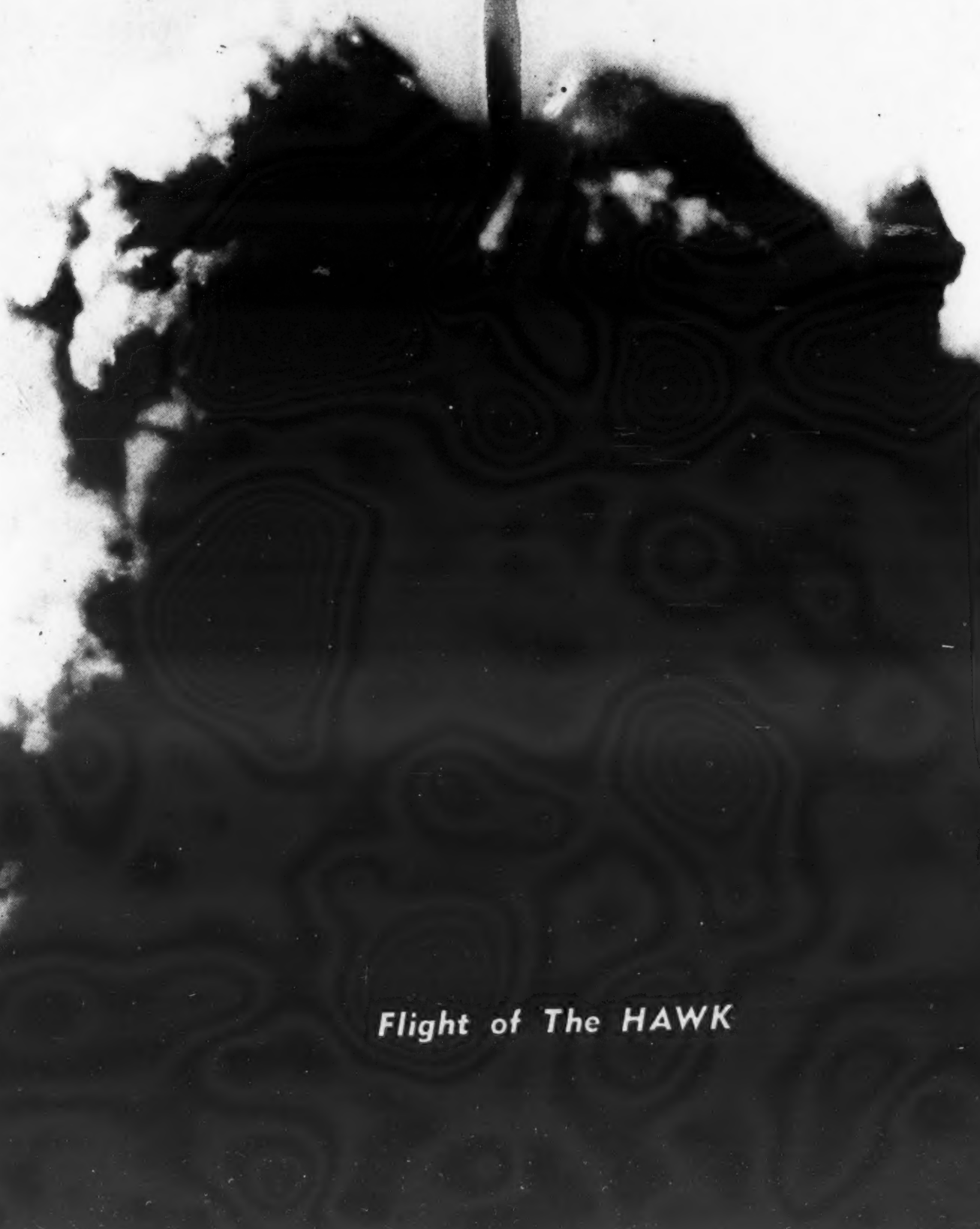
Communications—Electronics—Photography

July 1957

SIGNAL

AFCEA CONVENTION REPORT

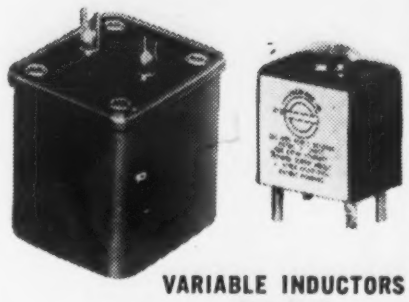


Flight of The HAWK

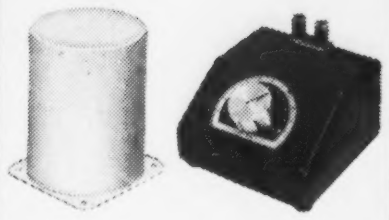
See Page 3

..FROM STOCK

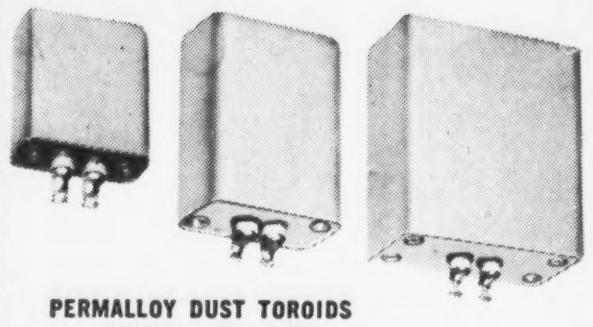
Write for your Copy of Latest Catalog.



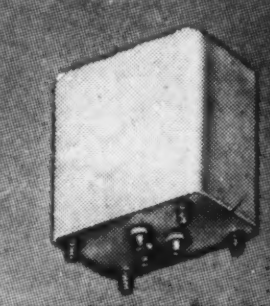
VARIABLE INDUCTORS
Standard,
Hermetic MIL-T-27A



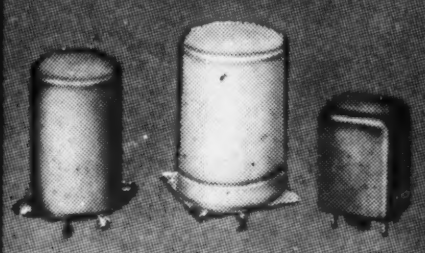
LOW FREQUENCY INDUCTORS
INDUCTANCE DECADES



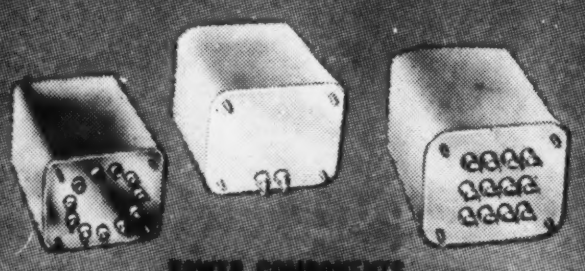
PERMALLOY DUST TOROIDS
Hermetic, MIL-T-27A
Highest Q, accuracy and stability



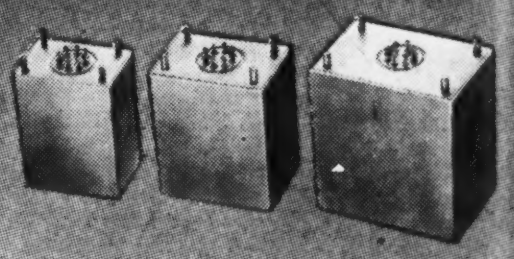
LOW PASS, HIGH PASS, BAND PASS FILTERS
Hermetic, MIL-T-27A



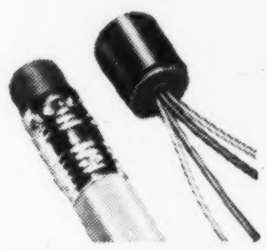
AUDIO COMPONENTS
Hermetic, MIL-T-27A
for every application



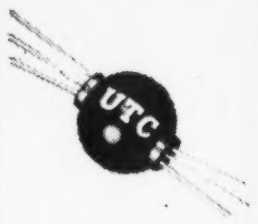
POWER COMPONENTS
Hermetic, MIL-T-27A
Power, Plate, Filament Transformers,
Filter chokes



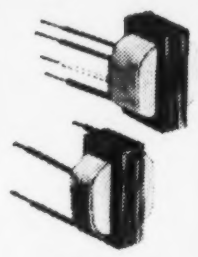
MAGNETIC AMPLIFIERS
Hermetic, MIL-T-27A



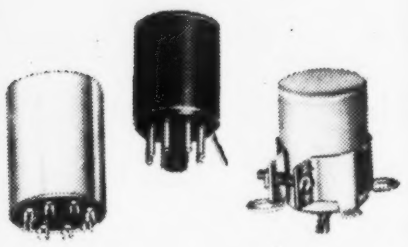
DECI-OUNCER
Transistor transformers .1 oz.
Hermetic, MIL-T-27A



PULSE TRANSFORMERS
Wound Cord, MIL-T-27A

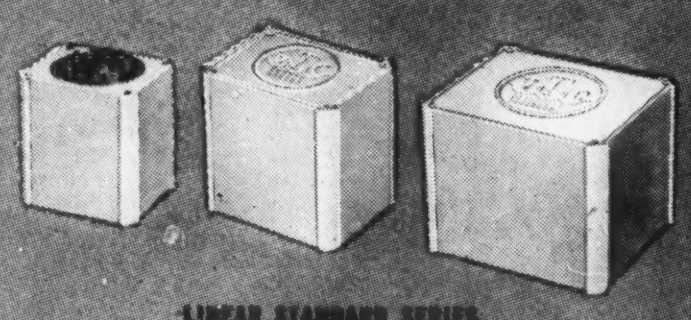


SUB and SUB-SUB OUNCER TRANSFORMERS
Audio and
Transistor

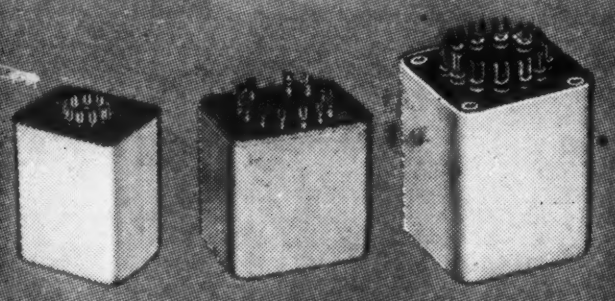


OUNCER AND PLUG-IN
Wide Range Audios

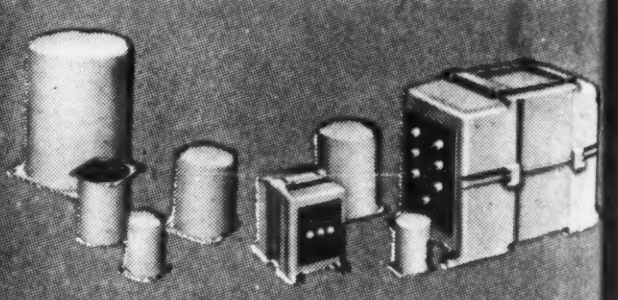
EQUALIZERS
Broadcast and Hi-Fi



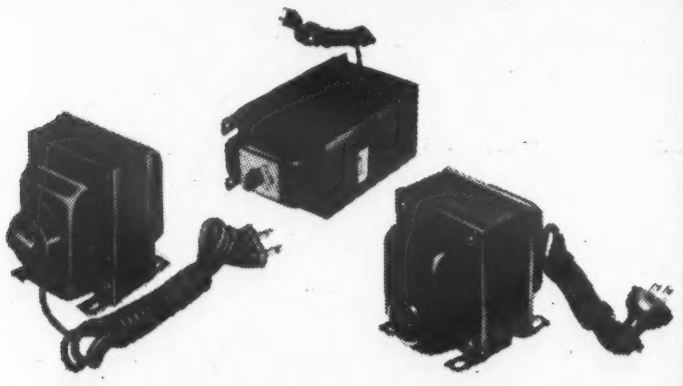
LINEAR STANDARD SERIES
Highest Fidelity Audio Units



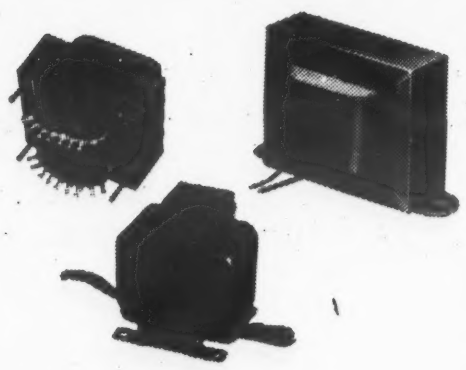
HIPERNALLOY AND ULTRA COMPACT
Broadcast and Hi-Fi Favorites



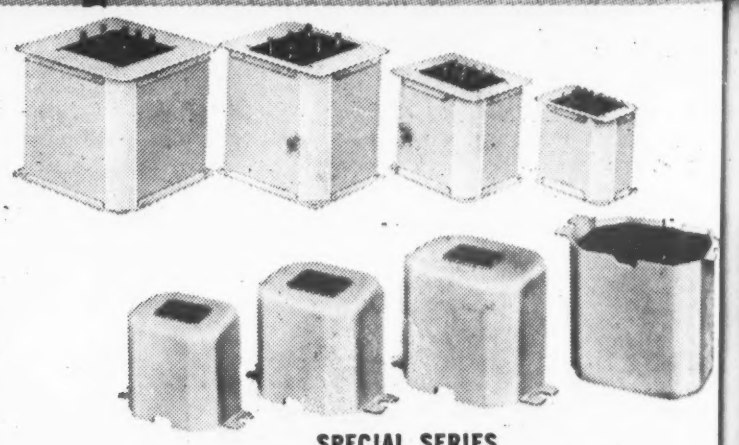
COMMERCIAL GRADE
Power and audio units for industrial service



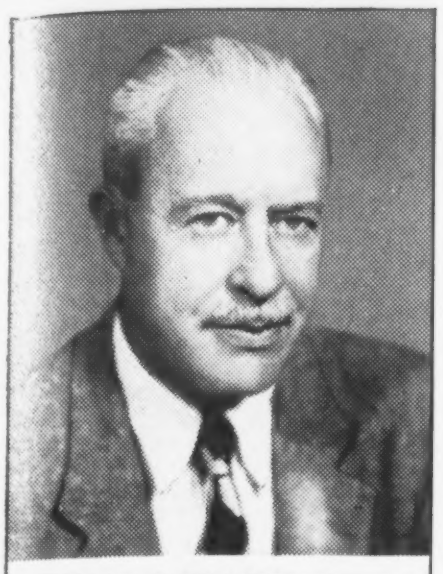
VOLTAGE ADJUSTORS . . . STEPDOWN and ISOLATION TRANSFORMERS



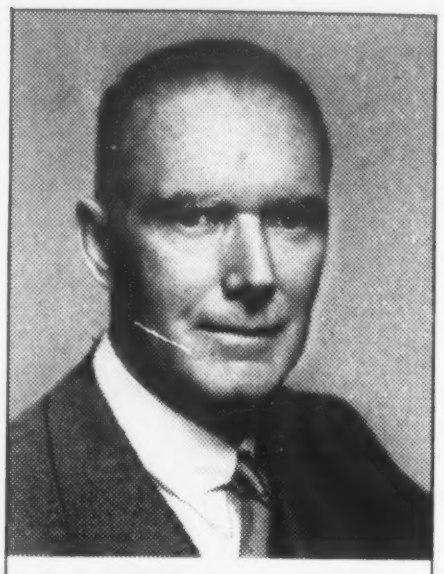
REPLACEMENT TYPES



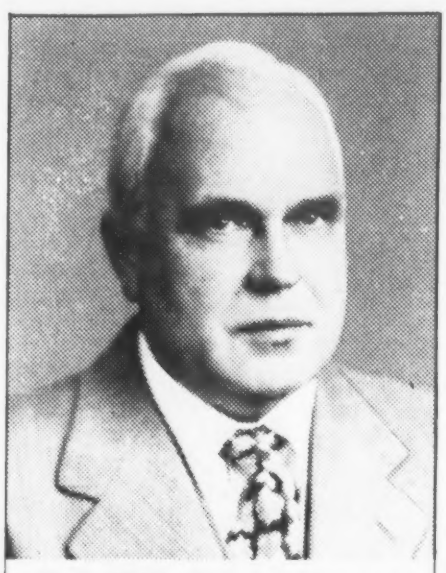
SPECIAL SERIES
Units for every amateur application.



WALTER H. BRATTAIN. One of three winners of the 1956 Nobel Prize in Physics for investigations on semiconductors and the invention of the Transistor, the tiny device which has created a new electronic era in communications.

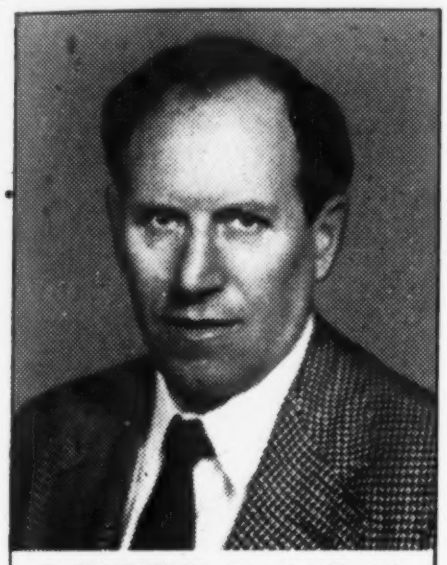


H. F. DODGE. Awarded Shewhart Medal by American Society for Quality Control, for original contributions to the art of statistical quality control—used by Western Electric in making millions of items of telephone equipment.

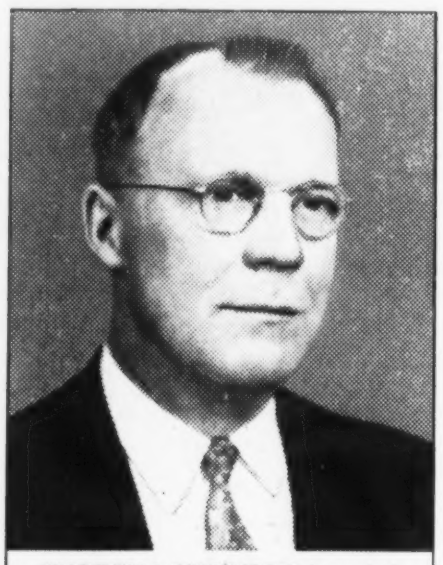


H. T. FRIIS. Awarded Medal of Honor, Institute of Radio Engineers and Valdemar Poulsen Gold Medal, Danish Academy of Technical Sciences for important work in application of short and ultra-short radio waves.

AXEL G. JENSEN. David Sarnoff Gold Medal, Society of Motion Picture and Television Engineers, for technical contributions to television; Hagemann Gold Medal for Industrial Research, Royal Technical College, Copenhagen.

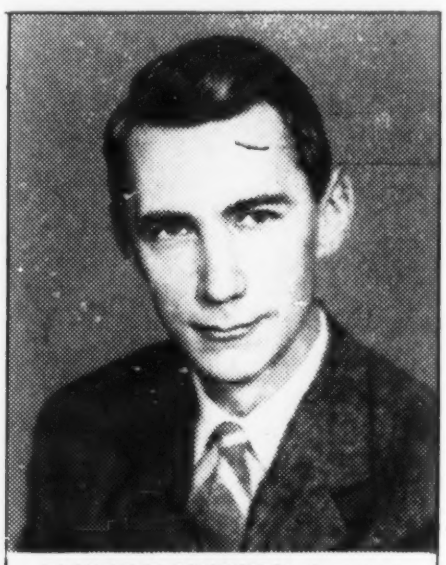


R. KOMPFNER. Awarded Dudell Medal by the Physical Society of England for his original work on the traveling wave tube. This new amplifier makes it possible for long distance microwave highways to carry more telephone conversations and TV programs simultaneously.



WARREN A. MARRISON. Awarded the Tompion Gold Medal, Worshipful Company of Clockmakers of the City of London, for pioneer work on quartz crystal oscillators as precision standards of time. This control of electrical vibrations is used to send many voices over the same telephone line.

W. G. PFANN. Awarded the Mathewson Gold Medal by the American Institute of Mining and Metallurgical Engineers for discovery of and pioneering research in zone melting. This provides the extraordinary purity of silicon and germanium needed in the manufacture of transistors.



CLAUDE E. SHANNON. Awarded the Stuart Ballantine Medal by the Franklin Institute for contributions to a comprehensive theory of communication. This greatly illuminates our understanding of how communications systems handle information. It points to new ways to improve service.

Partners and Pioneers in Progress

On this page are some of the Bell Telephone Laboratories scientists and engineers who have been honored recently for outstanding achievement in the sciences that bear on telephony.

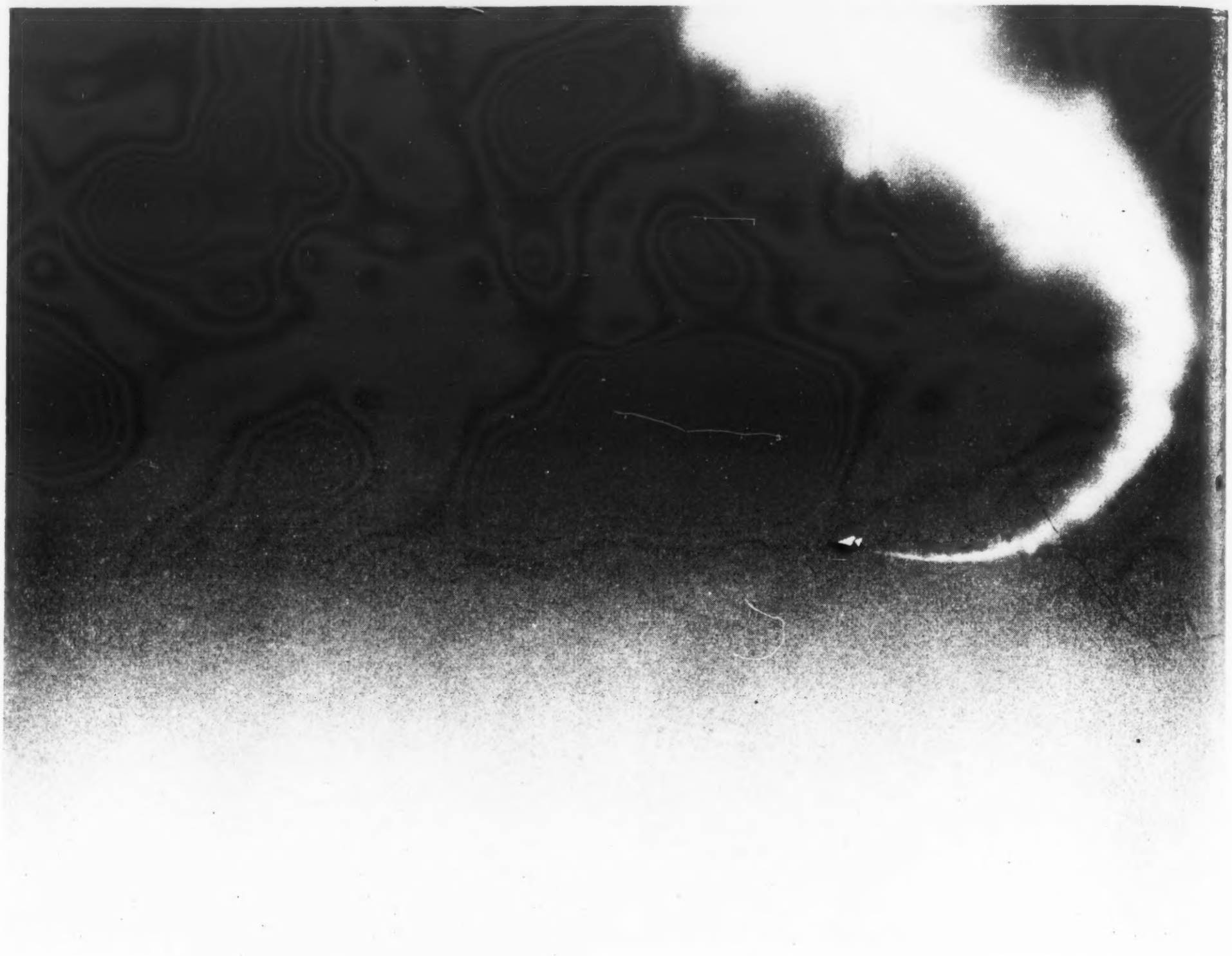
We are proud of this fine recognition of their work and the contributions of the many other engineers and scientists who are helping to make telephone dreams come true.

For always there have been dreams and high hopes in the telephone business. Growth begets growth. Research reveals new vistas. The words of thirty years ago are even more true today. "The future of the telephone holds forth the promise of a service growing always greater and better and of a progress the end of which no one can foresee."

A considerable part of that prophecy has been fulfilled. But great as the progress has been, there is still greater progress to come.

Never have there been so many opportunities for wholly new developments in telephone service and so much well-rounded research to put behind them. All that has been done is just the beginning.

Working together to bring people together . . . **BELL TELEPHONE SYSTEM**



in an instant —THE KILL

Twelve seconds ago, this hostile aircraft came in range of a Navy interceptor. Ten seconds ago, a little black box took control of the Navy craft's weapons system. Four seconds ago, it unleashed a salvo of deadly rockets. Two seconds from now the intruder will explode into a ball of fire.

The little black box that takes credit for the kill is the Mark 16 airborne fire control computer designed to make split-second decisions in high-speed aerial warfare. Credit for the black box goes to the Navy, to Lenkurt and other cooperating manufacturers. Developed to achieve a specific military objective, it is one of the unpublicized but highly important marvels of this electronic age. Everything else about it is classified.

But it can be said that Lenkurt's facilities are uniquely suited to undertaking "black box projects" for government and military agencies, for research, development, and precision production of telecommunications equipment.

Lenkurt equipment — carrier, microwave, and complete communications systems — is in round-the-clock use in many of our most vital defense installations. To see how Lenkurt may help on *your* next project, call in your Lenkurt representative or write direct.

Lenkurt
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Washington 6, D. C.
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BPA

SIGNAL

Communications-Electronics-Photography

Journal of the Armed Forces Communications and Electronics Association

VOLUME XI **JULY 1957** **NUMBER 11**

CONTENTS

Features

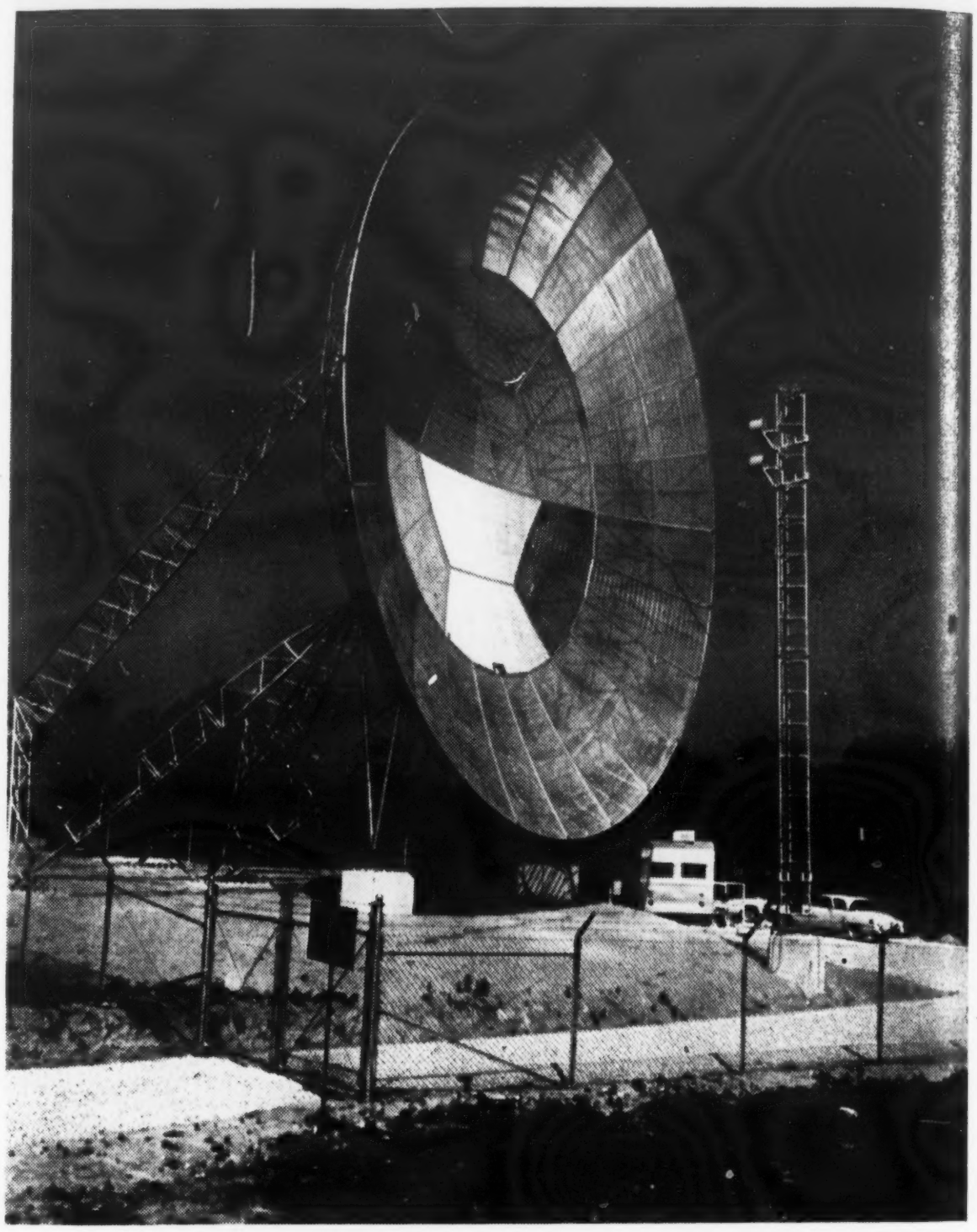
Appearing in the August issue: The convention symposium on Scatter Propagation by RAdm. Joseph N. Wenger and representatives from the Army, Navy and Air Force.

Cover

SIGNAL's *cover picture is the Army's new "Hawk" guided missile, a graceful 16-foot long missile only 14 inches in diameter. It is designed to help guard against enemy sneak attacks at* all *altitudes, and at distances far enough away to protect defended areas.*

The Hawk's radars can detect and track the low flyers in the blind zone of conventional radars and can be used at fixed installations and by fast moving combat troops. Raytheon Manufacturing Company is the prime contractor.

Electronics & Communications Engineers:



Sixty-foot paraboloidal-reflector antenna, typical of those tested and operated by PAGE for Lincoln Laboratory, M.I.T.

PAGE HAS DESIGNED AND CONSTRUCTED

9,000 MILES of scatter communication circuits since 1951

Page has worked with Lincoln Laboratory, M. I. T., the National Bureau of Standards, and the Western Electric Company in the development, or installation and operation, of 10,000 additional miles of scatter communications circuits. Current contracts call for 7,800 miles of new circuits. A pioneer effort unmatched by any other organization.

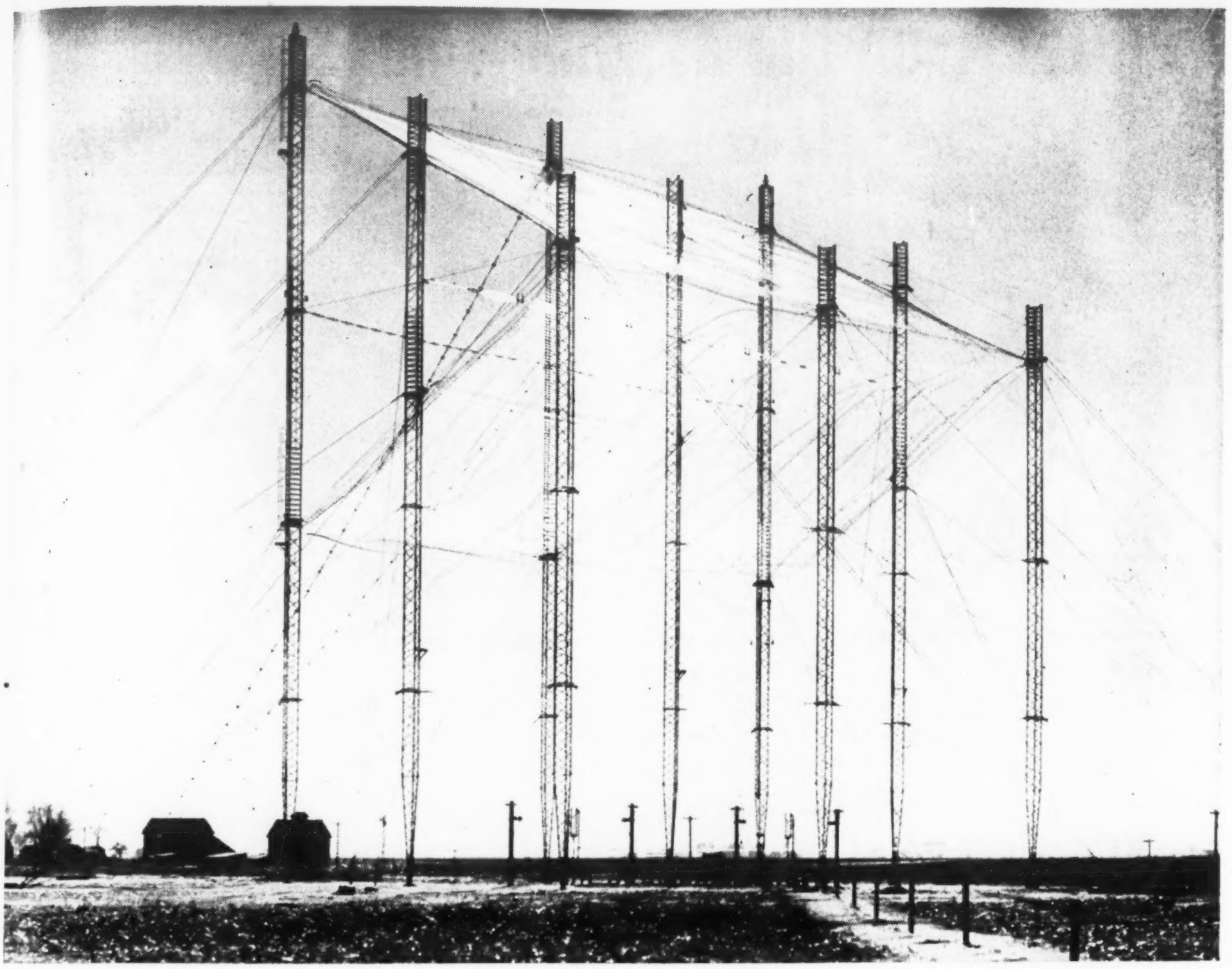
ATTENTION COMMUNICATIONS ENGINEERS:

We offer a sincere apology for a typographical error in a recent advertisement in SIGNAL!

Engineering accuracy necessitates this correction.

The copy read "current contracts call for 78,000 miles of new circuits." Obviously, this should be 7,800 miles.

Science fiction in electronics often turns out to be fact! Probably a few years from now, when this organization's services on scatter communication circuits have progressed farther, we will smile about this error because our headline might then easily read, "PAGE has designed and constructed 78,000 MILES of scatter communication circuits since 1951." But for the sake of accuracy, of course, we must correct the figure. And to help you identify our original message the complete two-page ad is repeated. We hope you will find it interesting.



High-gain corner-reflector antenna, designed, installed and test-operated by PAGE for Western Electric Company, under subcontract for DEW-Line project.

PAGE Communications Engineers, Inc. cordially invites you to visit our organization whenever you are in the Nation's Capital. Our work is internationally known and of increasing interest and significance. During the past seven years as pioneers in the design, const uction, testing and operation of scatter and other advanced radio communications systems, PAGE has played responsible and challenging roles in the building of multi-million dollar telecommunications networks.

Members of our organization are working closely with representatives of the U. S. and foreign governments and industries in the development of such systems. Challenging assignments take our engineers to many corners of the globe.

Due to the increased demand for PAGE-designed, installed, tested and operated systems, we now offer a few exceptionally interesting positions in our Washington, D. C. office as well as overseas.

Engineers who elect to locate in the Washington, D. C. area will find it offers outstanding educational, cultural and recreational facilities. As a center of Government-sponored engineering and research laboratories, it is particularly attractive to the engineer intent upon pursuing advanced studies. Urban and suburban housing is readily available in all price ranges and easily accessible to PAGE's main offices in the heart of downtown Washington.

Write for further details to:
Mr. J. P. Gaines
or phone EX 3-1523

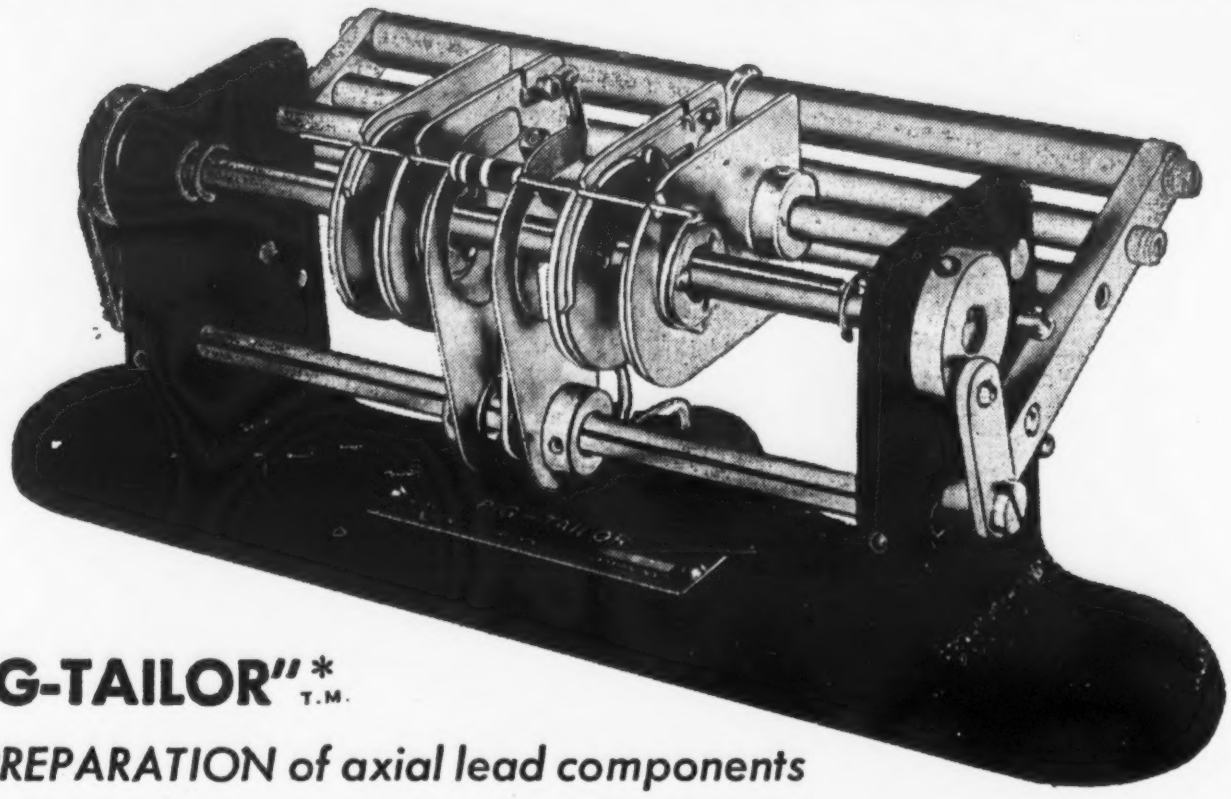
PAGE COMMUNICATIONS ENGINEERS, INC.

710 FOURTEENTH STREET N.W., WASHINGTON 5, D. C.

Branch Offices: Seattle, Manila, P. I., Oxfordshire, England.

Affiliates: Rixon Electronics, Inc., Page, Creutz, Steel & Waldschmitt, Inc.

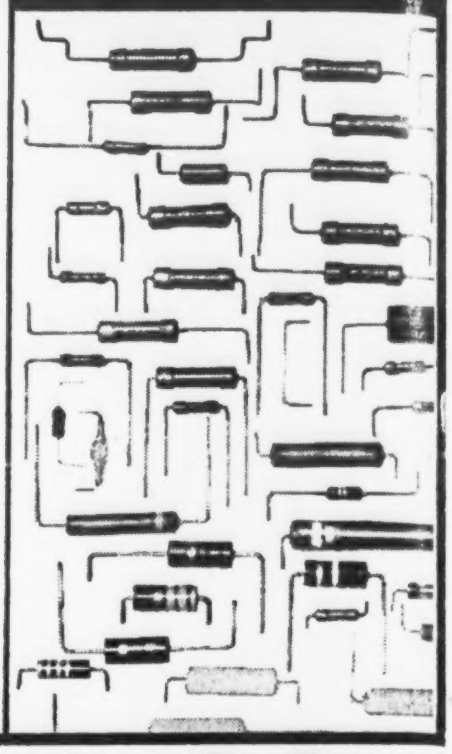
PROVEN-on the assembly line!



"PIG-TAILOR"* T.M.

For PREPARATION of axial lead components

PREPARED COMPONENTS IN SECONDS WITH THE "PIG-TAILOR"



"PIG-TAILORING"

. . . . a revolutionary new mechanical process for higher production at lower costs. Fastest PREPARATION and ASSEMBLY of Resistors, Capacitors, Diodes and all other axial lead components for TERMINAL BOARDS, PRINTED CIRCUITS and MINIATURIZED ASSEMBLIES.

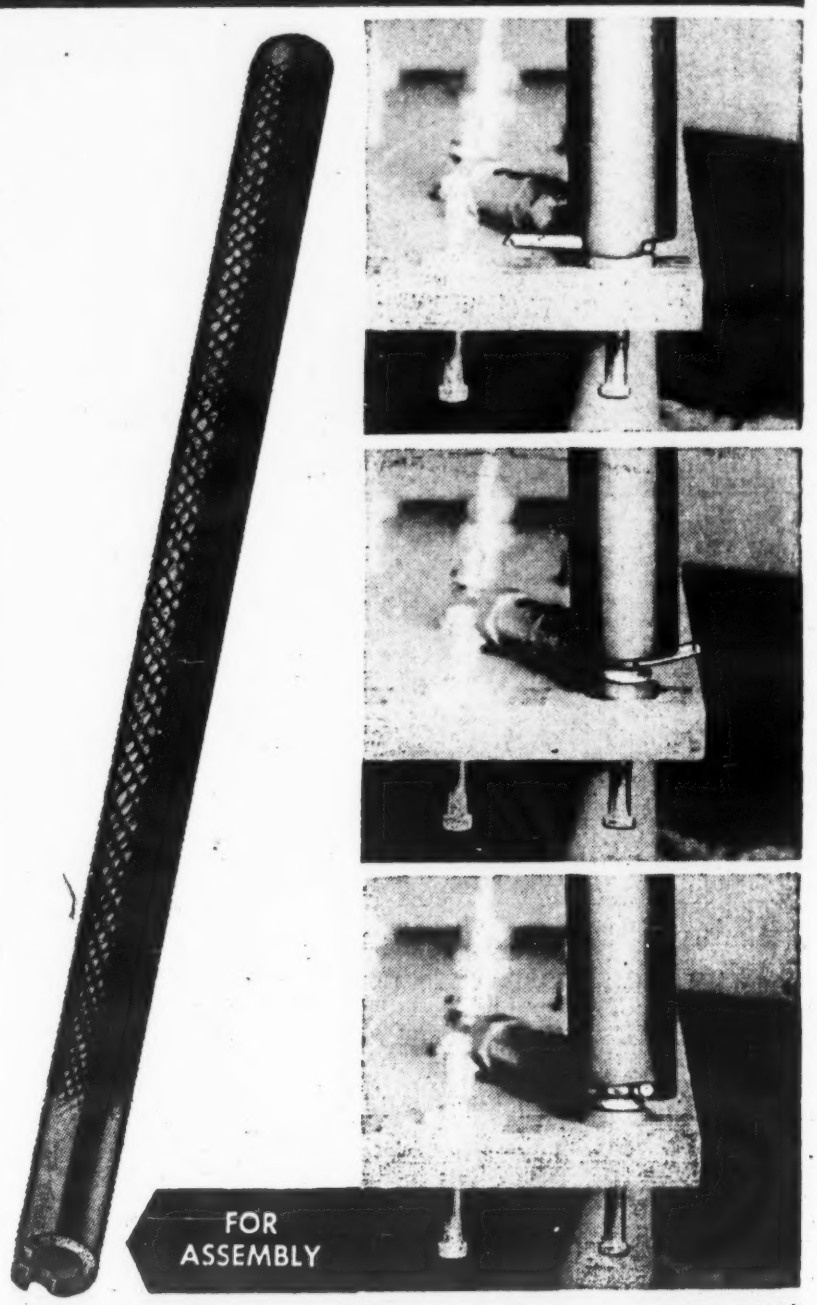
The "PIG-TAILOR" plus "SPIN-PIN"—accurately MEASURES, CUTS, BENDS, EJECTS & ASSEMBLES both leads simultaneously to individual lengths and shapes—3 minute set-up—No accessories—Foot operated—1 hour training time.

PIG-TAILORING provides:

1. Uniform component position.
2. Uniform marking exposure.
3. Miniaturization spacing control.
4. "S" leads for terminals.
5. "U" leads for printed circuits.
6. Individual cut and bend lengths.
7. Better time/rate analysis.
8. Closer cost control.
9. Invaluable labor saving.
10. Immediate cost recovery.

PIG-TAILORING eliminates:

1. Diagonal cutters!
2. Long-nose pliers!
3. Operator judgment!
4. 90% operator training time!
5. Broken components!
6. Broken leads!
7. Short circuits from clippings!
8. 65% chassis handling!
9. Excessive lead tautness!
10. Haphazard assembly methods!



"SPIN-PIN"* T.M.

Close-up views of "SPIN-PIN" illustrate fast assembly of tailored-lead wire to terminal.

* PATENT PENDING

Write for illustrated, descriptive text on "PIG-TAILORING" to Dept. S-7P

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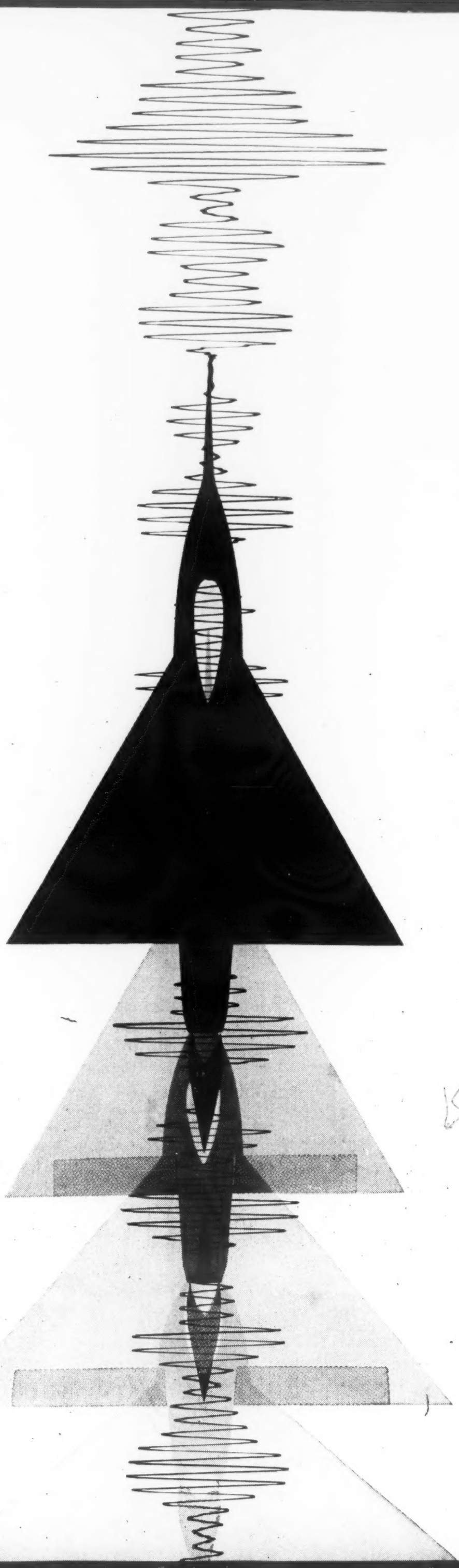
DESIGNERS AND MANUFACTURERS OF ELECTRONIC EQUIPMENT

460 WEST 34th STREET • NEW YORK 1, N. Y.



KEEPING INSTRUMENTATION A STEP AHEAD OF SPEED

AVIONICS IN ACTION AT BURROUGHS: FROM RESEARCH AND DEVELOPMENT TO PRECISION MASS PRODUCTION

Today's dramatic new developments in aircraft performance demand equally dramatic new developments in flight *instrumentation*. And Burroughs is assuming ever greater responsibilities in this field through its work in the brand-new science of *avionics*.

Examples? Past experience in mass production of such instruments as altimeters, accelerometers and gyros. Plus, of course, extensive research and development in totally new concepts of flight instrumentation. And in all these enterprises, *reliability* consistently keynotes our performance.

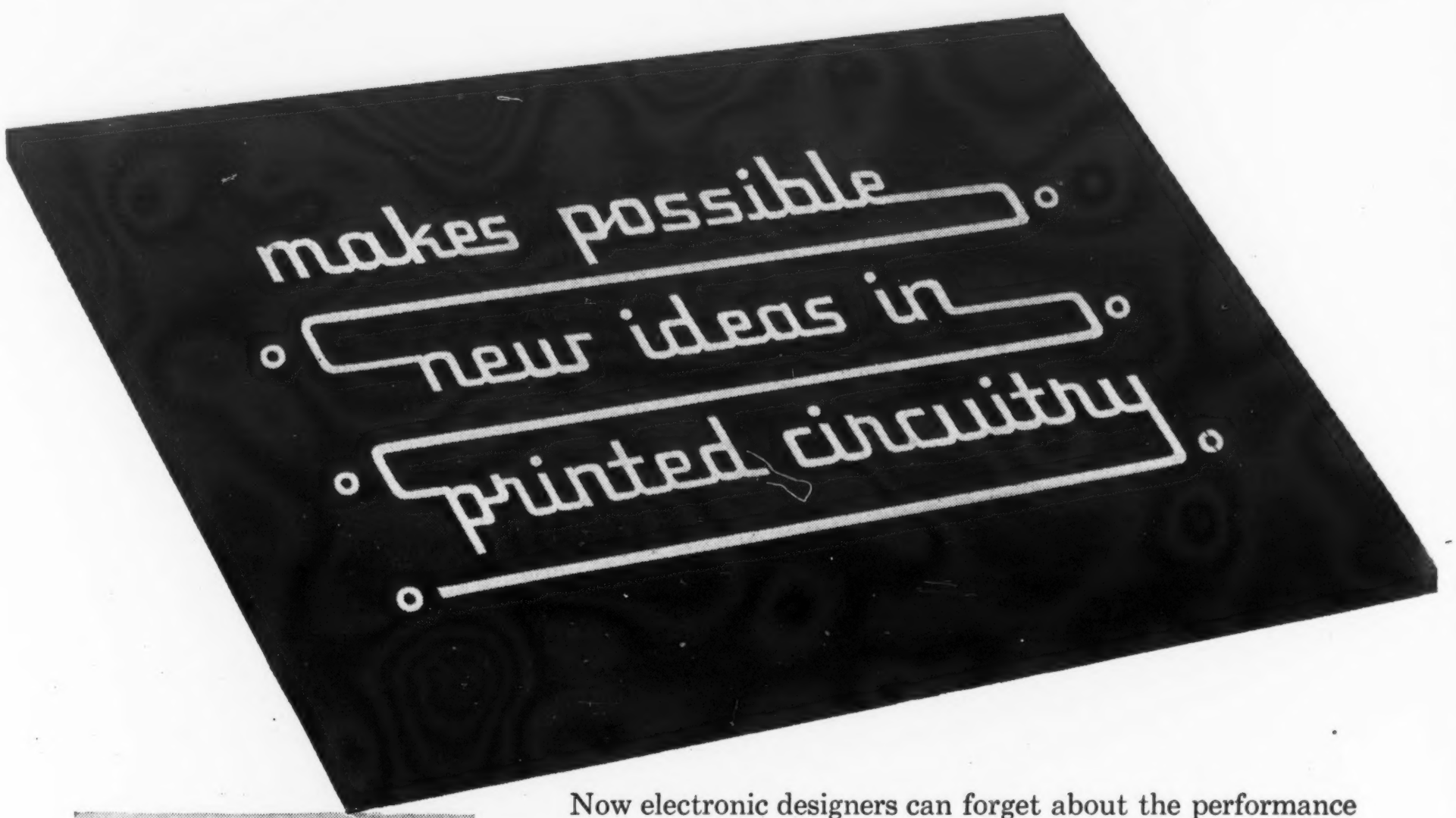
We have, too, the capabilities and facilities for further research and development in this fast-moving field. And in all areas of our proved responsibility and competence—not only instrumentation but control systems, electronic computation, communications, data processing and others—we stand ready to see defense contracts *all the way* through. Yes, from preliminary research to installation and field service.

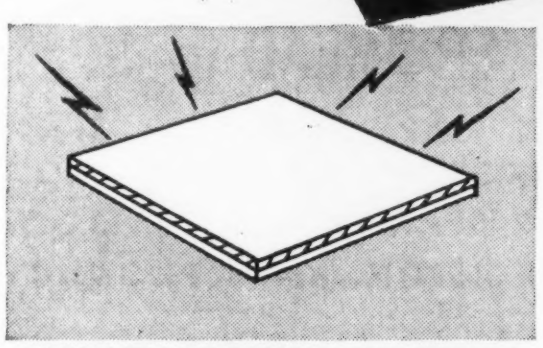
Write, call or wire Burroughs Corporation, Defense Contracts Organization, Detroit 32, Michigan. Or Burroughs Defense District Offices: Paoli, Pa. • Dayton, Ohio, 3898 Linden Ave. • Encino, Calif., 17071 Ventura Blvd. • Washington, D.C., 1739 "H" St. N.W.

BURROUGHS

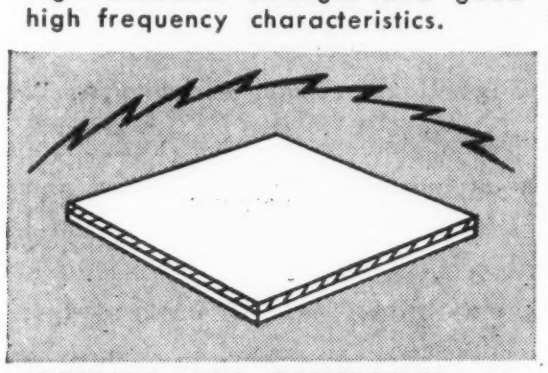
THE FOREMOST NAME IN COMPUTATION

NEW IRC *FLUOROPLY* LAMINATE

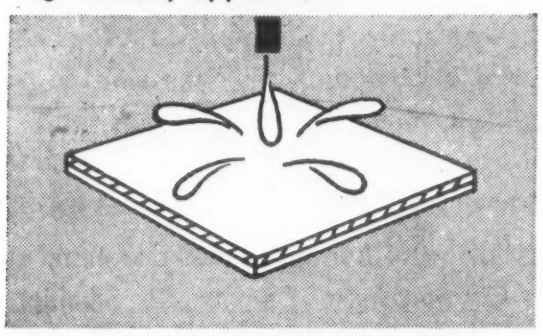




EXCELLENT ELECTRICAL PROPERTIES—High surface and volume resistivities, high dielectric strength and good high frequency characteristics.



SUPERIOR ARC RESISTANCE—Arc resistance of more than 360 sec. makes FLUOROPLY superior in high voltage and high humidity applications.



ZERO WATER ABSORPTION—FLUOROPLY's special fluorocarbon plastic base eliminates the problems of water absorption and humidity surface leakage.

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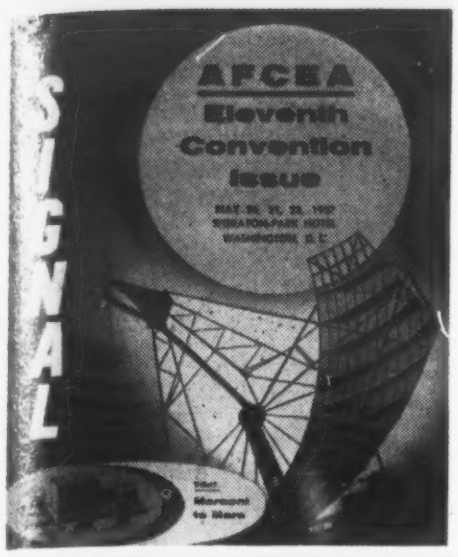


1957 AFCEA NATIONAL CONVENTION HIGHLIGHTS

editorial

The 1957 AFCEA National Convention lived up to its advance billing as the largest and most spectacular show yet conceived by the Association. With eight months of pre-convention coverage in SIGNAL, coupled with pre-advertising and a superior job of selling by William C. Copp and Associates. the Convention set a new record with 150 exhibits and attendance of over 3100. Considering that the AFCEA Convention is a "closed show," this performance is truly par excellence. From the Association viewpoint. the show must be called a hit. Included in the attendance figure were foremost industrialists and executives. top-flight military leaders from all services, governmental officials, educators, scientists, management experts, university students and many other distinguished representatives from other areas of our national society such as procurement and contracting agencies of Government. This type of representation meant much to the exhibitors and provided contacts of value.

National headquarters recognizes that a success of a convention depends on many factors and principally upon the efficient execution of sound planning and long hours of hard work. On behalf of the Convention President, Percy G. Black, and the AFCEA membership, the Association wishes to express its appreciation to Admiral Joseph R. Redman, Convention chairman, and the various members of his committee whose sterling contributions left nothing to be desired. Those to whom special recognition is due are: Social Committee—John Gilbarte; Publicity—Roland Davies; Technical Sessions—Francis Engel; Transportation & Tours—George Sheets, and Ladies Activities—Mrs. Frances Engel.

Convention Toastmaster

The Association is especially indebted to Mr. George W. Bailey for his contribution as the convention toastmaster. Mr. Bailey, in his own refreshing style, filled this position with ease and perfection.

The convention was honored in having student representation from colleges and universities in and around the Washington area and from Boston, Mass. Of particular significance was a large representation of students from the highest military college, the Industrial College of the Armed Forces, Fort Leslie J. McNair, Washington, D. C. These students included representatives from the Army, Navy, Air Force, Marine Corps and the civilian agencies of Government. Following the graduation from the Industrial College last month, many of these students have been assigned to key positions in the fields of production, procurement and contracting in the Nation's Capital.

Last, but not least, hats are off to Colonel Olmsted, Mrs. Godfrey, Mr. Martins and the representatives of the administrative and editorial staff of National Headquarters for their long hours of work before and during the convention. Along with the personnel of Mr. Copp's staff, they served untiringly to make the 1957 show the success it was.

Ladies Activities

Under the capable direction of Mrs. Frances C. Engel, Chairman of the Ladies Committee for the AFCEA Washington, D. C., convention, the visiting ladies to the Nation's Capital enjoyed a program of entertainment that will be long remembered. The sincere compliments which were received from many of the ladies attending the convention is an indication of the excellent planning by Mrs. Engel and her committee.

Approximately 54 ladies registered from locales outside of the Washington, D. C. area and were joined by an equal number from the District.

Before the opening breakfast at the Sheraton-Park Hotel and a briefing of events by Mrs. Engel and Mrs. Redman, Mesdames Saddler, Clark and Finlay acting as hostesses performed a fabulous "get-acquainted" service. Following a review of plans for ladies activities, the group departed for Fort McNair where they were received at the home of Mrs. James D. O'Connell. After a social hour at Mrs. O'Connell's, approximately 100 ladies attended a luncheon at the Fort McNair Club where they were entertained by the talented singer, Sylvia Merrill, and her accompanist, Mrs. Rucker. Other activities which highlighted the ladies' program consisted of a tour of Georgetown and its historic homes under the direction of Mrs. Percy Black; a visit to the National Capitol conducted by Mrs. Finley, and a visit to the National Gallery of Art which was arranged and conducted by Mrs. Wenger.

The ladies convention committee was most appreciative for the cigarettes which were furnished at the social events by the Philip Morris Company. Also, a vote of thanks is due Mrs. Jacocks for having arranged for special favors which were presented by Julius Garfinckel & Co., Frank R. Jelleff Co., the Chesapeake & Potomac Telephone Co. and the First Federal Savings and Loan Association.

National Headquarters of AFCEA is profoundly thankful and appreciative to Mrs. Engel for her unselfish devotion to a difficult task but one which, we understand, she enjoyed no end. The following is a list of members of the ladies committee: Mesdames Engel (chairman), Black, Clark, Finlay, Finley, Jacocks, O'Connell, Redman, Saddler, Wenger.

Some of the Banquet Guests

Frederick R. Furth, Rear Admiral, USN (Ret.)
Director, Research and Development
International Telephone & Telegraph, Corp.
National President, AFCEA

Welcome Aboard

Rear Admiral Frederick Furth, a native of Seattle, Washington, received his appointment to the U. S. Naval Academy, Annapolis, Md., in 1920. Following graduation from the Academy, he served as a junior officer aboard the battleship, *USS Mississippi*. In 1926 he reported for duty aboard the *USS Sacramento* and, while attached to that vessel, participated in the Yangtze Campaign and in the armed landing at Canton, China. He served consecutively on the *USS Smith Thompson*, *USS Chase* and *USS Dent*, units of Destroyers, Battle Force, U. S. Fleet, until May 1930.

In that year, Admiral Furth proceeded to Annapolis for postgraduate instruction in Communication Engineering, following which he continued instruction at Yale University, New Haven, Conn., where he received his Master of Science degree in June 1932.

He was then assigned to the *USS Tennessee* as Radio Officer, and in June 1933 became Division Radio Officer on the staff of Commander Battleship Division Three. He served in this capacity for two years, when he was ordered to duty in the Office of Chief of Naval Operations, Washington, D. C. In 1937 and '38, he became Communication Officer on the staff of the Commander, Battle Force, and later was on the staff of the Commander in Chief, U. S. Fleet.

Between 1940 and 1945 Admiral Furth served in the Office of the Chief of Naval Operations. He was one of the two Navy members of the U. S. Radar Mission to the United Kingdom. For his wartime contributions to the development of radio, radar, sonar, and other electronic equipment, he received the Legion of Merit. He was promoted to the rank of Rear Admiral on July 1, 1953, while serving as Assistant Chief of the Bureau of Ships for Electronics.

As Chief of Naval Research in 1954 and '55. Admiral Furth directed the expansion and use of new techniques in the Navy's continuing support of upper atmosphere research, a program that has permitted the Navy to move ahead rapidly with the technical portion of the earth-satellite program. Upon his retirement in 1956, he joined the International Telephone and Telegraph Corporation as Vice President, Research and Development of its Farnsworth Electronics Co. division, and is presently the Director of Research and Development for I. T. & T. in New York City. Admiral Furth is a member of the American Society of Naval Engineers (President, 1955); Society of Naval Architects and Marine Engineers; Associate Fellow of the Institute of Aeronautical Sciences; Fellow, American Association for the Advancement of Science; Scientific Research Society of America; Naval Order of the United States; Senior Member of the Institute of Radio Engineers and is now President of the Armed Forces Communications and Electronics Association. AFCEA extends its new Skipper a hearty *"welcome aboard."*

Northeastern University
receives
Chapter of the Year Award

PRESENTATION

The announcement and presentation of the tenth annual Armed Forces Communications and Electronics Association Chapter of the Year award was made during the convention at the annual banquet, Tuesday, May 21, 1957.

The recipient of this coveted award was the student chapter of Northeastern University. This was the first time that a student chapter has gained this recognition in competition with the other chapters of the Association. In presenting the award to Cadet Wilfred J. Picard, Jr., president of the Northeastern University student chapter, National President, Percy G. Black said: "It is with tremendous pride that I make this presentation to the Northeastern University Student Chapter as the outstanding AFCEA chapter for 1956-57. Their enthusiasm and activities have earned for them this national recognition of accomplishment. Many of you in the audience this evening have become acquainted with the outstanding representatives present from Northeastern University. I am sure that all of you would like to join with me in applauding the "Chapter of the Year."

Address to the University and College Students at the Student Symposium
By
Major General James D. O'Connell, Chief Signal Officer, USA

GENERAL JAMES D. O'CONNELL, Chief Signal Officer of the United States Army, speaking to the assembled students from the colleges and universities in the Washington, D. C. area and the student representatives from Northeastern University, Boston, Mass., at the annual convention, outlined the aims and objectives of the AFCEA. He also stressed the mutual benefits accruing to industry and military members through their affiliation with the Association. General O'Connell went on to say that "this relationship between industry and the military has come a long way since World War I. Actually, it was immediately following World War I that the full meaning and importance of the civilian-military team concept became a recognized must in preparedness planning and for the strengthening of our national security.

"Today, we cannot overlook the importance of training more students in engineering and mathematics. There is a definite responsibility on the part of our citizens to encourage young men to pursue scientific courses in our high schools and colleges. One of the projects presently being studied by AFCEA is the development of ways and means to encourage and attract more students into these courses. Concurrent with this project is a study directed toward the creation of educational guidance criteria for high schools so that they will recognize the shortage of trained young men in the scientific fields and will do something about it.

"On the military side, we in the Signal Corps, are proud of the opportunity which we offer to college graduates with BS degrees joining the military service. We afford them the opportunity to pursue an educational program for advanced degrees in engineering and other sciences. The military spends time and money on this challenging project and the results are a source of considerable satisfaction. If we are to have competent and trained manpower so necessary for our future security, we must set our sights not only on keeping pace with the U.S.S.R. but on exceeding their increased progress in the development of scientifically educated and academically trained youth. To fall behind the Soviet Union and their program for world dominance in this field would create a serious situation for the U. S.

"I wish to congratulate all the students attending this conference and the panel discussion group, composed of representatives from Northeastern University. Northeastern University is indeed worthy of the highest commendation for the enthusiasm and interest which they have displayed during the past several years in connection with the ROTC activities in communications, electronics and photography. We, in the Army Signal Corps, are proud of the caliber of graduates which we are receiving from Northeastern—they make excellent officers."

Percy G. Black, Colonel, USA (Ret.)
Assistant Vice President
Automatic Electric Company
Past National President, AFCEA

Joining the military ranks at reveille near the turn of the century, a son, later named Percy G., reported for duty to the late Maj. Gen. William M. Black, Chief of Engineers, World War I. Percy began his soldiering career after receiving his B.S. degree from the U. S. Military Academy in 1917, followed by distinguished service in positions of great responsibility during two World Wars. After retirement, he joined the Automatic Electric Company, Washington, D. C., and for the past eleven years has served as Assistant Vice President.

Among his many decorations, Colonel Black received the Silver Star, Legion of Merit, Bronze Star, Purple Heart, and the Officer's Cross of the Order of Polonia Restituta. During World War I he served with the 76th Field Artillery, 3rd Infantry Division, participating in 5 major combat operations in France. Later, military duty carried him to foreign assignments in Hawaii, Germany, Japan, and China. Of note is Colonel Black's assignment as the Assistant and Acting Military Attache for the U. S. Embassy, in Berlin, Germany, from 1937 to 1940. In this capacity he was in close contact with the European political, military and economic situation, traveling extensively throughout Germany and visiting nine European countries. His reports on the German military and economic preparation of war and his observations of seven German regiments and the German 3rd Corps' invasion of Poland are historical intelligence. He returned to the U. S. in 1940 to present a series of lectures on the German campaign in Poland at the Army War College, Command and General Staff College, and various camps in the Eastern U. S.

After duty as G-2 for an Armored Force, Colonel Black was assigned to the Intelligence Division, War Department General Staff, where he pioneered in the study of psychological warfare and organized the Psychological Warfare Section of the Intelligence Division; initiated the organization of the combat propaganda company; supervised studies by Drs. Gutherie and Claude Robinson to devise a method of public opinion research to determine the factors affecting the morale of troops; organized the geopolitical section of the Intelligence Division W.D.G.S.; and initiated establishment of a joint Psychological Warfare Committee of the Joint Chiefs of Staff.

The preparation of the Intelligence plan for the invasion of French Morocco (1942-43) was made by Colonel Black and it was during the landing operations that radio was used for combat propaganda for the first time. He participated in the landing at Fedala Beach near Casablanca.

In April 1943, Colonel Black was assigned as A. C. of S., G-2 European Theater on General Andrews' Staff, and was later transferred to the Intelligence Division, Chief of Staff Supreme Allied Commander (COSSAC), which prepared the plans for the invasion of Europe. April, 1944, found Percy reassigned to the office of the A. C. of S., G-2 War Department General Staff, where he served as Chief German Specialist and Chief Western European Specialist. After a colorful, prominent military career, Colonel Black retired from active duty in 1946. Always living his Alma Mater's motto of "Duty, Honor, Country," he established a distinguished military record which stands as a challenge for the officer of tomorrow.

Along with his busy days at the Automatic Electric Company, Colonel Black enjoys his affiliation with the Army Ordnance Association, Association of the United States Army, Army and Navy Club, 1925 F Street Club and the Chevy Chase Club.

For the past year the Armed Forces Communications and Electronics Association has been indeed fortunate to have had the honor of Colonel Black to serve as its National President. He became active in AFCEA affairs in 1948 and has held the positions of Program Chairman, Washington Chapter, President of Washington Chapter, Chairman National Convention, and member of the National Executive Committee and Board of Directors. Colonel Black's outstanding background and capability along with his wonderful sense of humor and enthusiasm are the characteristics that have helped our Association to progress, along the military and civilian lines. SIGNAL salutes our past AFCEA National President who has served us so very well. Bien fait, Percy.

CONSTITUTIONAL CHANGE REFLECTS EDUCATIONAL PROGRAM

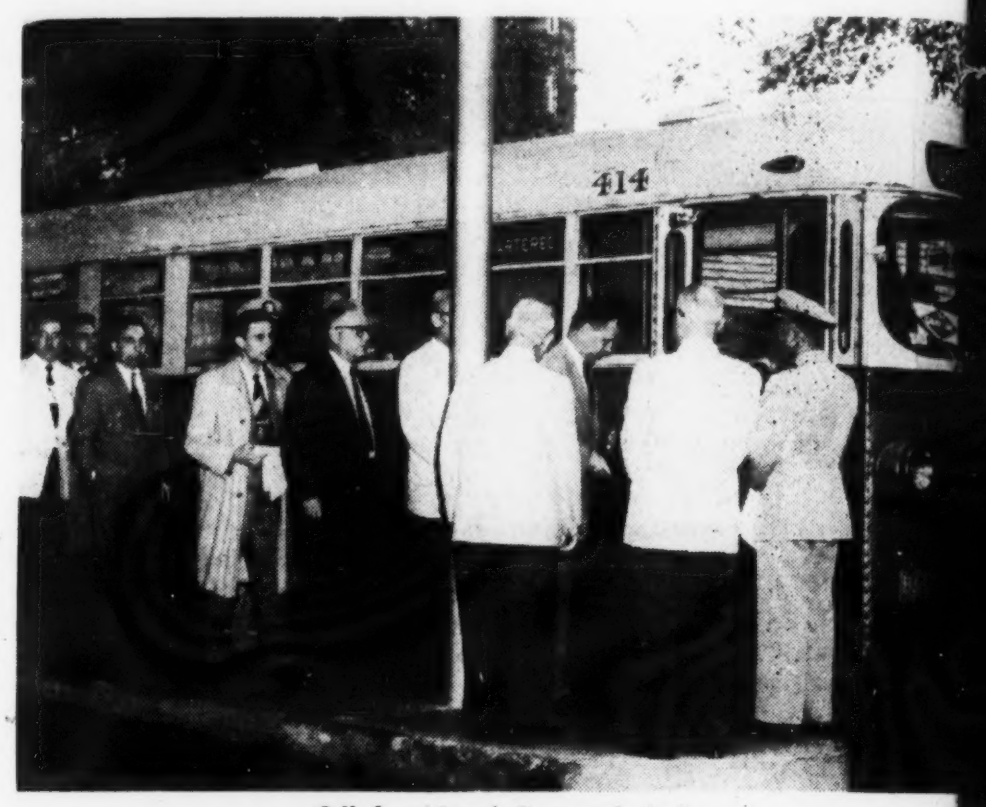
Colonel Percy G. Black, speaking on the importance of a student educational program, said: "The question of student education goes far beyond the ROTC chapters or the student chapters or the affiliated chapters. It is my conviction that the grass roots of this problem begin at the junior high school level. Here is where we must concentrate our effort. The responsibility for this educational program rests solely and squarely on the shoulders of our chapters. The student educational program is one of the most important responsibilities which we, as an Association, have ever undertaken. I strongly recommend that each chapter president get in touch with the Board of Education in his community to see what can be done in the high school and junior high school to stimulate interest among the students in taking courses which will enable them to pursue scientific and engineering courses. This is essential in order to bridge the gap which has already widened too greatly if we are to preserve our national heritage."

In furtherance of this educational program, the following addition to the second paragraph of the preamble of the constitution of the Armed Forces Communications and Electronics Association was made at the Eleventh National Convention to read (addition underscored):

> *"The Association endeavors to maintain and improve the cooperation between the Armed Forces and Industry in communications, and in the design, production, maintenance and operation of communication, electronic and photographic equipment in time of peace as well as in time of war, and, in addition endeavors to foster appropriate measures towards the development of adequate reservoirs of scientists and engineers in the United States of America."*

CONVENTION PHOTOS

Scatter Propagation Panel.



Off for Naval Research Lab.

Chapter representatives at the Chapter Presidents' conference were:
Arizona, Atlanta, Baltimore, Boston, Chicago, Dayton-Wright, Fort Monmouth, Gulf Coast, Kansas City, Lexington, New York, Northeastern University, Orange, Philadelphia, Pittsburgh, Rome-Utica, San Francisco, Scott-St. Louis, South Carolina, Southern California, Southern Connecticut and Washington.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BOSTON INSULATED
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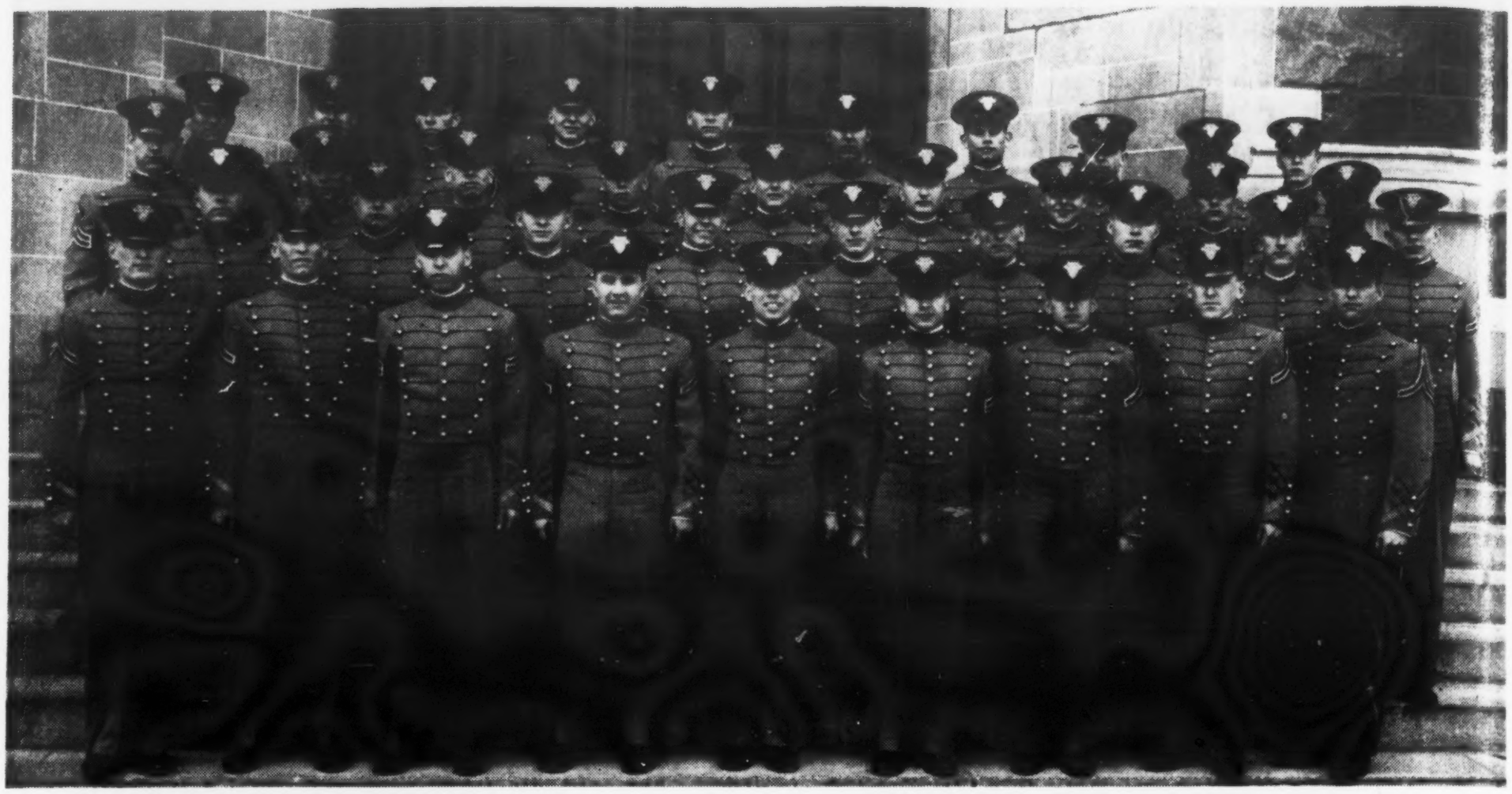
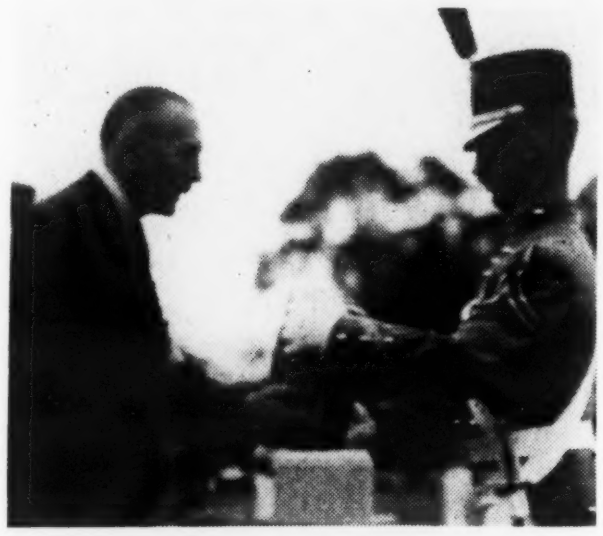
AUTONETICS



USMA Recent Graduates—Newly Commissioned 2d Lts., Signal Corps, USA.



Col. Black presents AFCEA award to Cadet J. H. Vickers for highest rating in Electrical Engineering.

H. Harriss Robinson (Motorola) presents AFCEA award to Midshipman F. R. Haney for highest award in Electronics.

Left to Right

★ Front Row
1. Ketchum, R. E.
2. McDonald, T. B.
3. Marrella, L. S.
4. Bullotta, A. L.
5. Caldwell, R. G.
6. Walton, C. A.
7. Gross, F. W.
8. Stein, M. K.
9. McDaniel, J. L.

★ 2d Row
1. Elder, J. F.
2. Fox, B. P.
3. Martin, R. F.
4. Wright, W. K.
5. McLaughlin, J. O.
6. Smith, D. L.
7. Wilhelm, E. A.
8. Bone, A. N.
9. Schumacher, H. J.

★ 3d Row
1. Stackhouse, D. R.
2. McEvoy, L. D.
3. Langworthy, R. A.
4. Chittick, P. J.
5. Adcock, T. G.
6. Buckner, D. A.
7. Reget, G. R.
8. Roebuck, T. W.
9. McCullum, C.

★ Back Row
1. Tobin, K. D.
2. Albright, A. F.
3. Howes, R. H.
4. Pearson, T. J.
5. Jenkins, J. R.
6. Salzman, J. D.
7. Erickson, D. J.
8. Head, B. F.
9. Bowes, D. J.
10. Kidd, W. E.

30 Years in Electronics

by RAdm. Dwight M. Agnew, USN (Ret.)

JUNE 6, 1957. CREI CELEBRATES ITS 30TH!

Thirty years in the Electronics field should merit a corporation the title of being a Pioneer. On June 1, 1927, Capitol Radio Engineering Institute was incorporated. When one considers that CREI's life-span is contemporaneous with the early days of the vacuum tube as well as that of commercial broadcasting, the title of "Pioneer" appears amply deserved.

During the past thirty years CREI, here in the Nation's Capital, has attained the reputation of being one of the leading educational institutions in the electronics field. CREI has maintained this position by constantly shaping its courses to the ever-changing applications of the various basic but inter-related electronic techniques.

The story of Capitol Radio Engineering Institute can not be told without mentioning its founder and president, Mr. E. H. Rietzke. Mr. Rietzke developed the first "vacuum tube course" for the Navy's Advanced Radio Materiel School at Bellvue here in Washington. During the first three years of that school's existence he was its Chief Instructor. At the time, Mr. Rietzke was a Chief Radioman in the Navy.

Realizing that there was no comparable course available to industry, he decided in 1926 to write and market such a course. This he did, incorporating in 1927. As he says, "I started with $250 and a prayer." Today he heads one of the leading electronics educational institutes in the country.

To provide some idea of the magnitude of CREI's effort, the residence school body numbers over 500 students, while its correspondence school enrollment includes over 14,000 active students. Forty-eight States and the Territory of Hawaii are represented in the resident school's student body. In addition, the following foreign nations are represented in the student body: Australia, Canada, China, Colombia, Costa Rica, Dominican Republic, Estonia, Greece, Hong Kong, Indonesia, Iran, Italy, Lebanon, Pakistan, Philippines, Poland, Spain, Switzerland, Thailand, Turkey, Venezuela, and Yugoslavia. Foreign representation in the correspondence division is even more diversified.

On June 6, 1957, CREI celebrated its birthday with a 30th Anniversary Banquet at the Mayflower Hotel. Mr. Everett Corey, Registrar of the Institute, was the master of ceremonies. The Institute's president, Mr. Rietzke, gave his views on "The First Thirty Years are the Hardest." Other speakers included Mr. George Bailey, Executive Secretary of the Institute of Radio Engineers, present director and former president of AFCEA, and Dr. Henry Armsby, Chief for Engineering Education of the U. S. Office of Education, Washington, D. C.

Other distinguished guests included The Honorable Olin E. Teague, Representative from the 6th Congressional District of Texas; Captain Gordon Caswell, U.S.N., representing Admiral H. C. Bruton, Director of Naval Communications; Mr. Edward E. Booher, Executive Vice President, McGraw-Hill of New York; Mr. Thomas E. Whinerey, Vice President Riggs National Bank; Colonel Burnett Olmsted, AFCEA, and Colonel W. J. "Sparky" Baird, AFCEA, editor of SIGNAL Magazine; Mr. Sol Taishoff, President of Broadcasting Pubs. Inc.; Mr. Rome D. Leandri, Chief Vocational Rehabilitation and Education Division and Mr. James Argyropoulos, Chief, Benefits and Facilities Section, both of Veterans Benefits Office; Mr. Boise L. Bristor, Secretary, Veterans Advisory Committee D. C. Board of Education, and Mr. Paul A. Snearling, Administrative Assistant to Deputy Superintendent, D. C. Public Schools.

The Board of Directors, the Institute's executive officers and their staff and the faculties of both the residence and the home study divisions attended. The student body was represented by Mr. Kenneth F. Haddox, student body president.

Happy Birthday, CREI. May the next thirty be equally successful.

Rear Admiral Albert Girard Mumma, U.S.N.
Chief, Bureau of Ships

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Today's defense needs are bringing science's best minds to grips with the problems of outerspace communications. Avco-Crosley salutes these trail blazers of a new dimension.

Avco-Crosley's own advanced programs in communications and radar already embody much of the knowledge demanded for man's next great undertaking: *to hurl his thoughts, his voice, and even himself* far into the unknown realms of outer galaxies.

As Avco-Crosley sees it, today's great research and development expenditures gain us more than strength in a troubled world; they speed our scientific readiness for the fabulous new world of tomorrow.

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Eleventh Annual Banquet Address

Stairway to the ★ ★ ★ ★ Stars

Donald C. Power
President
General Telephone Corp.

MR. PRESIDENT, MR. TOASTMASTER, distinguished guests, and members of the Armed Forces Communications and Electronics Association, I am most honored and grateful for this opportunity of addressing this audience, which I truly believe to be one of the most forward-looking and useful groups operating in the national interest today. These are words of praise, but I do not utter them lightly. Yours is still a comparatively young branch in over-all developments in the art of communications. This is an art which began with the age-old struggle of mankind to span the distances of the earth with channels of intelligence along which ideas and information could move faster than any physical form of travel.

If we go back far enough, we would find that in times gone by governments in all nations have usually been interested in scientific inventions for one of two reasons, either to gain some military advantage or to find something new to tax. Yet, through the ages, some very minor developments have had profound consequences. The map of the world today has been drawn by some of those extra pushes of individual genius, those sparks of initiative which have changed entire channels of human events. As the ancient Chinese proverb puts it, a single pebble may be enough to alter the whole course of a mighty river.

Some historians may sniff at such hindsighted speculation, I know. They call it "if reasoning." Yet, consider what the world's outlook would be today if Cleopatra's nose had been a half-inch longer, or if the Spanish Armada had not been wrecked by sea storms, or if Napoleon's cavalry had the advantage of good weather instead of rain at the battle of Waterloo. We might even go so far as to wonder whether if Plymouth Rock had landed on the Pilgrims, instead of the Pilgrims landing on Plymouth Rock, we would not all be speaking Spanish to each other here this evening.

The point I am making here is that, as practical men, whether in government or business, we have to take things as we find them. And on that basis, the record of accomplishment in the field of military communications and electronics has been one of which you can be justly proud.

The only trouble is that you cannot say very much about that record, for obvious reasons of security. Many of the wonderful things your people have done, and are now doing, may never be known publicly, at least in the foreseeable future. As a businessman who believes in advertising, I am afraid I would find such restrictions frustrating. In private business, trying to get along without advertising is something like trying to wink at a pretty girl in the dark. You may know what you are doing, but she doesn't!

So, all the more credit is due to you people who are in the Armed Forces or must work on classified projects, because you must forego the normal satisfaction of public recognition and must go on blooming like the rose in Thomas Gray's poem, "born to blush unseen and waste its sweetness on the desert air." Of course, it is really not as bad as all that, or we would not all be here tonight at this fine banquet. And if there has been any noticeable blushing around here this evening, it might be due to the blooming of more than one rose—maybe as many as four roses!

I reminded you a minute ago that yours is a comparatively young branch of the communications art. Let us consider briefly the facts on this. A mere hundred years ago, there was no telephone. The telegraph was still a curiosity, first used for military purposes in the Crimean War. It has been less than eight decades since Alexander Graham Bell's discovery of the telephone; less than six decades since Marconi amazed the world with the transmission of intelligence without wires; less than four decades since the perfection of the vacuum tube. The rapid development of radio and television within the past three decades should make us wonder just what will be the state of this art within another mere decade!

Miracle in the Making

Those of you who went over to the Naval Research Laboratory this afternoon to witness the preparations being made there, for the earth satellite Vanguard, saw a miracle of communications in the making—an earth-made moon to be launched during the coming year. After that has been accomplished, it is not too farfetched to suppose that there will be communications of a sort with the moon itself, and with the planet Mars and

other celestial bodies in the not too distant future.

And so it may very well come to pass that the span of the communications art "From Marconi to Mars," which I understand is the theme of this convention, will actually be witnessed within the lifetime of some who are now living, possibly some within this very room tonight. One of the main purposes, as I understand it, of the earth satellite Vanguard is to establish a completely new form of communications—to obtain data concerning temperatures and other conditions of outer space from which signals of communications will be sent back to earth for study and coordination.

And if the name of the project, Vanguard, is prophetic, there will be other earth satellites. Each will add to the sum total of knowledge and experience which may well some day add up to the first space travel of man himself.

So if we want to look at these developments in such a light, those who have any part to play in this marvelous art of modern communications are contributing, each according to our talents, to the building of these stairways to the stars. It is a truly thrilling objective. And I salute this eleventh annual meeting of the Armed Forces Communications and Electronics Association on its imaginative theme, "From Marconi to Mars."

Exchange of Ideas Vital

As one whose own background has been mostly that of law and management in the telephone end of the communications business, I cannot and will not presume to discuss any of the technical matters which occupy your attention during this convention. But I would remind you that business management has its own duties and responsibilities in this field. Unless business management can cooperate intelligently with those of you who operate in the realm of scientific research and experimentation, the whole future of the art could fall under the shadow of misunderstanding and languish for lack of practical support. That is why it is so important for an organization, such as this, to bring together the various professionals and experts and businessmen for the exchange of information about what is going on in each theater of activity. In this manner, all of us may contribute in forging links of future communications which I have called, somewhat fancifully, a "stairway to the stars."

After all, there are all too few meeting places where communications experts, in the armed services, and in the Government civilian services, and in the communications and electronics industries and allied public services, can freely talk with each other in the same language. Yet this also is a form of communications, in the broadest sense of that term, which is most essential. My own job puts me constantly "in the middle" of various professionals, technical experts, and specialists, all trying to work toward the same objective. And for that reason I can well appreciate the value of any forum or common denominator for the mutual exchange of ideas. And that is a role for which this association is particularly suited. We simply cannot afford to lose touch with each other, by neglecting or overlooking the opportunities which meetings of this sort provide.

Role of Telephone Industry

The telephone industry has long been a natural breeding ground as well as a practical testing place for research and development of great importance in many aspects of the art of military communications. There are sound and practical reasons for this. First of all, the telephone business functions in about the same natural range of operating frequencies and circuits. Telephone business research concentrates on compact components, which require only a small amount of activating power. Within these limitations telephone research has constantly striven for longer range, more accuracy, fidelity, selectivity, and all the rest of those qualities which military communications engineers are always seeking. Out of such research have come almost incredible discoveries and techniques admirably suited even for the all-important guided missile program, which stands so high today on the list of our national defense planning.

Aside from this coincidence, in the utilization of similar electronic phenomena, another down-to-earth reason why the telephone industry has become a natural testing ground for building these stairways to the stars is the simple fact that the day-to-day bread-and-butter operations of the telephone industry necessarily involve the very same phases which command the attention of Armed Forces communications and electronics experts. These include research and invention, physical construction, and actual service operations. So, it would be strange indeed, if our telephone people had not long ago discovered a natural affinity with the Armed Services in their respective activities.

The most important reason of all, however, for this close alliance between the telephone industry and our government scientists and armed services has been that well-known truism that communications is our first line of defense. This is one military maxim which has not changed in principle since the days of the Caesars.

This alliance between our telephone industry and our Armed Forces has existed from our very earliest days, when automatic dial switching was being tested and proven in our independent telephone industry operations, right down to the present day when the Deputy Secretary of Defense happens to be a former career official and executive of Bell Telephone Laboratories and Western Electric. I refer, of course, to Donald A. Quarles, who as Secretary of the Air Force spoke to you just a year ago at this banquet session of your 1956 convention.

And just to prove that the good use being made by the government service of telephone industry "alumni" is a two-way proposition, I would like to refer, in passing, to your National Association President, Colonel Percy G. Black. He has for some years, as most of you know, been serving as the Washington representative of the Automatic Electric Company, an affiliate of the General Telephone System. I am honored to be thus associated with Colonel Black in business as well as personal friendship.

As Secretary Quarles pointed out to you last year, on this very platform, there is need for more and more of this close co-operation between our communications industries and government research for defense purposes, if we are going to meet the challenge of competition behind the Iron Curtain. Today, the historic affinity between our communications industry and the national defense goes much further than such specific projects as the networks of submarine cables, the DEW line of radar, and the SAGE system of co-ordinating radar defenses against hostile attack. I would direct your attention to the "built in" defensive network of telephone communications which covers the Nation with over 60 million telephones—a potential alert system which reaches into nearly every American home and business place. It is a system which is already there, in place, and now in working order, spanning the continent and penetrating into the most remote areas. It af-

fords almost complete mass contact with our 170 million American population.

In the telephone business there has always been a strong sense of trusteeship with respect to national defense. The independent and Bell system companies have generally assumed that they had an industrial obligation to help our country win wars and preserve peace.

This co-operation with the national security interest, moreover, has developed along lines which the telephone industry has naturally followed to meet its own technological needs. I can say to this audience that the telephone industry is going to need every feasible idea that communications research people can come up with, in the years just ahead of us. We are going to need new circuit capacities, new appliances, and operating improvements, such as electronic switching (of which we hear so much promise right now). We are going to need the vast additional use of existing circuits likely to become available with the perfecting of those newly developing techniques for compressing information of all kinds into tiny bits or pulses which can be flashed in tremendous message volume within the twinkling of an eye. Only last month Bell Telephone Laboratories demonstrated an experimental device for sending messages over ordinary telephone wires at the rate of a thousand words a minute or 16 times faster than conventional teletypewriters. We are going to need bigger and better trunk cables and more mobile telephone appliances. In fact, any new improvement in the art which will enable our telephone plant to carry more traffic load is going to be put to good use.

Cooperation Means Progress

Our scientists tell us that there is no absolute horizon or limit of what can be done once a given problem is reduced to a rule or an accepted principle. Anything that can be rationalized can be accomplished. Actual demonstration in physical form then becomes a matter of research and application. Our Nation's ability to defend itself against hostile attack is going to depend largely upon advances in the military communications art. Of course, we have some pretty good competition from abroad.

A great deal of concern has been expressed about the strides being made by the Soviets in atomic development, in guided missiles, and other secret weapons of modern warfare. It would be most unrealistic to discount any of this. But I cannot believe that forced contributions of scientific effort and of technical developments and of labor will prove superior, over the long range, to the progress we can make under the cooperative relationship which exists in this country between our Armed Forces and our communications industries.

Our electronic research in this country is not dependent upon foreign scientists who had to be kidnapped as prisoners of war. Nor is it dependent upon virtual slave labor: nor upon the dragooned resources of a population, such as the people of Russia, who only last month saw their life savings confiscated by a callous repudiation from their own government of a solemn bonded debt obligation.

Therefore, the obligation lies upon us that much more heavily to prove that we, as free and independent men and women, voluntarily working with our government services, can produce a better end result in this rivalry of brain power, money power, muscle power, and—above all—will power! Speaking from the standpoint of our private enterprise system, I say to you that we cannot fail, and we will not fail, in this critical test of our American way of doing things.

Dangers of Satisfaction

It is certain that we never shall, in our lifetime, see any degree of complete achievement. Things which seem wonderful to us today, will not be good enough tomorrow. We know that the contest must go on and on, in an endless progression of measures and countermeasures and counter-countermeasures.

One of the most useful functions which this Association can serve is to be a safety valve to protect all of our scientists and specialists from falling under the spell of their own achievements. Understand, I do not say there is any such present danger of self-hypnosis. But it is conceivable that it could happen if our research people should ever become too insulated from contact with practical operations.

Sometimes, when we contemplate such superautomatic devices as the so-called "electronic brain," we may even wonder whether we humans will always remain the masters of these magic machines. We know, for example, that if we feed enough accurate and balanced background data into these machines, we can find out things about ourselves that we did

(*Continued on page* 24)

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Invention Needs a Market

It is a curious thing that the most fruitful periods of progress in the telephone business occurred whenever a big new idea came along at the same time that a market for exploiting that idea had developed or vice versa. We might compare the idea to a baseball, and the market to a baseball bat. Now we all know that when a bat connects with a baseball, in the right way, the ball generally goes some place. When Bell first discovered the telephone in 1876, and for a number of years after that, it was simply an idea in search of a market. It took quite a little while before the financial and business people, in those days, stopped looking upon the telephone as a toy or a lecture platform curiosity and began to take it seriously as a reliable means of mass communications. But with the expiration of the Bell patents in 1893 and 1894, and with the establishment, almost overnight, of thousands of independent companies in almost every town and village where Bell system companies had not yet been established, there developed a mass market for telephone service and equipment. And then it was not long before we had a market in search of ideas.

More recently, of course, we have witnessed a successive number of hits in the field of radio and television and the telephone industry has tried to "stay on the ball," as it traveled far and wide. And once more, we now seem to be entering a period in the telephone industry where we have markets in search of new ideas, which will enable us to handle more traffic over existing plants, or at least over proportionately less expensive plant facilities.

This little background brings me, finally, to one small meat-and-potatoes portion of an idea I would like to leave with you tonight. I would like to touch briefly on the shortage of trained people so much needed by both industry and government in the electronic and communications field.

In the first place, it must be admitted that nobody can tell a scientist what to discover. Management can only prepare favorable soil and cultivate the more promising plants, and hope for the best. Both government and business management can no more tell an inventor what to invent than a patron of the arts, in bygone days, could tell a Beethoven what kind of music to compose, or a Michelangelo what to paint.

What we can do, I repeat, is to provide the soil and suitable climate. The crying need today is to get more fertile plants, growing in our brain pastures. In plainer words, we must find ways to get more qualified people interested in scientific and engineering careers. It is not one of those problems like a temporary shortage of doctors, or lawyers (if there ever was a shortage of lawyers), or farmers, or skilled mechanics—a problem which always seems to solve itself eventually by the operation of the old reliable law of supply and demand. I think there are three things industry and government can do about this—co-operatively.

One thing is to make certain that whatever amount of technical assistance becomes available, such talents can be fully and completely utilized. Industry should be able to assure these people of interesting and rewarding jobs, where their energies and abilities will not be frittered away.

Steps can also be taken to provide on-the-job training. There are plenty of real opportunities in the telephone industry, I am sure, for scientific and technical "interns," so to speak, to increase their skills and broaden the scope of their abilities by actual experience under responsible supervision.

The 3 "M's" of Industry

And along the same line, we cannot afford to overlook the very earliest stages of selection. I mean the schools and colleges. A good many suggestions have already been made for co-operative support of formal education for qualified students, even in the secondary schools. We cannot afford to wait for these vocations to come along entirely by spontaneous combustion. Many a promising embryonic engineer has been sidetracked into a less rewarding calling simply because nobody was there to point out the detour.

Private industry, of course, cannot do its share without the necessary support from its own financial operations. The telephone business, like other public utilities, has long been under pressure to satisfy a growing need for the three "M's"—manpower, money, and materials. The greatest of these needs is money. Without it, we just cannot hope to get the other two.

I am not going to take your time talking about our financial troubles in the telephone industry, when I know you have plenty of your own. But most of you are aware, I am sure, that both our independent and Bell companies have had to go to our state regulatory authorities repeatedly since the end of World War II, and especially since the Korean War inflation, to get rate increases. Sometimes we get them and sometimes we do not. Most often we get half a loaf or a portion of what we ask, and we try to get along. Telephone rates in the United States, on the general average, have increased only in the order of 50 per cent over prewar levels, or less than half the increase in the general cost of living for other necessary items. I mention this only by way of pointing out that the private communications industry has problems of its own, in meeting its public service responsibilities. And if we cannot always do as much as we would like, in supporting all proposed co-operative projects, the answer is likely to be found there.

Mammoth Task Lies Ahead

In conclusion, I would like to remind you that we are all in the same boat, so to speak, when it comes to assisting our ship of state to sail on its appointed course in these troubled times. We all have our respective oars to pull, whether we are laboring in the government section or in the business section. If we can all pull in unison — a unison which can come only from understanding each other's tasks and responsibilities—then surely we will have progress.

We might even look at it this way. History has got to happen some place. So, it might as well happen here, perhaps right here at this convention. Whether you realize it or not, all of you members have it within your power to participate, however modestly, in an over-all long-range objective, so dramatically called to mind by the theme of this convention, "From Marconi to Mars." Lives there one among you who would not be proud to make his contribution towards the erection of a mystical structure of future communications, which you will never see completed, one which will have no ending in time nor in space? It is a real man-sized job you have taken on, one which will separate the men from the boys. It is the building of a "stairway to the stars." Thank you all very much.

RAdm. Rawson Bennett
Chief of Naval Research

Keynote Luncheon

SCIENTIFIC RESEARCH AND MODERN TECHNOLOGY

★ ★ ★ ★

IF A RIP VAN WINKLE WOKE UP today after a sleep of ten years or so, he would find that our way of living has been amazingly transformed. He would be dazzled by the appliances we have in our homes, the cars we drive, our new forms of communications and entertainment, the machines that run our business and industry—all of which have either been vastly improved or in some cases did not even exist when he last viewed the world. He would find it incredible that nuclear power, which was then barely a dream, is now a reality not only in driving ships but in supplying commercial electric power.

He might also be somewhat horrified to learn that there now exists the hydrogen bomb which can sow far greater destruction than the atomic bombs that blasted World War II to an end. On the other hand, I hope he would be comforted with the knowledge that we are now rapidly building a Navy of nuclear-powered ships equipped with guided missiles and supersonic carrier-based jet planes that extend our defenses against enemy attack thousands of miles from our shores.

His first question would be, what has brought this about in the brief span of a decade. The answer, in a word, would be science. We would tell him that the explorations of our scientists in the unknown areas of man's environment have produced the advances of the past ten years. But this is nothing new, he might say. Science has always supplied us with new theories that have pointed the way to progress in our civilization. This is true enough. The big difference is that prior to World War II scientific research was comparatively ignored. Today it is big business drawn on heavily by both industry and the military services to produce our current technical triumphs. Recent comparative figures show that in 1941 the amount of money spent in this country on physical science research was about $1 billion, including both public and private. Today the total is more than $5 billion, with private industry accounting for nearly half.

Science and Research

In explaining the change, we must include another factor, more subtle perhaps but just as important. During recent years the military services and industry have become increasingly aware that one can no longer function in isolation from the other nor can they afford to work at cross-purposes. Each is now greatly dependent on the other. The technical superiority of our Armed Forces is in direct correlation to the extent that industry can produce. Conversely, the incentive and support for much of industry's advancing technology come from the needs of the military.

Research or, more precisely, Government support of research on a large-scale basis, has been the catalytic agent that has molded together the military and industry, and the Navy played a leading role in initiating this process. The first major plunge of the Government into research was the wartime Office of Scientific Research and Development (OSRD) which carried through to successful completion the work on the atomic bomb and other important military developments. However, OSRD closed up shop as soon as the peace was signed. At that point the Navy decided that if it wanted to gain any benefit from the important discoveries of wartime research, it must promote continued research in areas of significance to the Navy. When the Office of Naval Research was established in 1946, the Navy found it stood almost alone in the support of scientific research, particularly in the field of basic research which was receiving support from virtually no other source. From the beginning, the Office of Naval Research has operated on the premise that almost any problem solved by the scientist is likely to benefit the Navy. The Navy regards science and research as a cornucopia of knowledge from which we can draw freely to satisfy our technological requirements. For example, improved radar and sonar equipment grow out of the latest theories of the physicist or the metallurgist or the chemist. Work in the esoteric field of solid state physics leads directly to new types of electronic devices, including miniaturized systems.

One of the chief characteristics of our rapid technological progress since the end of the war is that the span of time between theory and practice has steadily decreased. In less than a decade the Navy had advanced from pure theory to the actual production of nuclear-powered combat ships. At present, the time between a theory and a critical experiment may be as short as a week. As a result, we are now developing ideas that were not even theories a decade ago. An example is the idea of rocketing an

earth satellite into the upper atmosphere at a speed of 18,000 miles an hour, which will then circle the earth hundreds of miles up while automatically sending back information to us.

The Groundwork

It should be noted that the genesis of this new development was fundamental or basic research, the exploration of the unknown that is carried on in the universities and in some of the more advanced industrial laboratories. It is this search for the "how" and the "why" that is the essential groundwork of all scientific endeavor and supports all of the technical advances of the future. The product of basic research is new knowledge. The accumulation of this new knowledge forms a storehouse upon which applied scientists and engineers must draw if they are to develop anything really new.

The close alliance of the military and industry carries with it a joint responsibility to make certain that this storehouse is never exhausted. It would be fatal if, in our preoccupation with fabricating a shiny new piece of hardware, we neglected the creative scientist who produces nothing but a piece of paper. The man in the research laboratory cannot give us a new device all wrapped up and ready to be plugged in. He simply turns over to us a new theory or principle that has been carefully worked out by assembling and examining all sorts of bits and pieces of information. But this new theory is likely to be the key to several new devices, some of which we had never thought of before. Essentially this is why much of the work supported by the Office of Naval Research is basic research done under contracts with scientists in universities, in other non-profit institutes and in commercial laboratories.

Benefits

The payoff in basic research is never immediate, but the wait is well worthwhile, and there is usually a bonus for your investment. Furthermore, it makes sense for industry and the military to have a deep mutual interest in research since both are likely to benefit from the same study. The physicist, the chemist, and the metallurgist by puzzling out and explaining the operation of the basic forces of nature make it possible for the Navy to build better radar sets, design more accurate missile guidance systems, and develop more efficient fuels for jet planes and rocket motors along with the type of combustion chamber required to burn them. The very same principles can be utilized by industry to make striking improvements in communications, provide the push-button homes of tomorrow, and build the more efficient, less complicated cars of the future. Research in mathematics and physics gives the Navy more advanced electronic computers, which are now essential equipment in modern warfare. These same computers are revolutionizing modern business.

Mutual Interests

Moreover, whether a research project is carried out by a defense agency with a military use in mind or study is conducted by an industrial concern for commercial purposes, it frequently happens that a development important to both results. For example, before the war, a research program in the organic chemistry section at DuPont set out to explore the general subject of polymerization and the general problems connected with the structure of substances of high molecular weight. The result was nylon, which proved to be of tremendous value to the Allies during World War II.

Recently the Navy initiated a research program to develop a similar aircraft instrument panel. An important component was to be a flat plate television tube. We wanted the tube to be transparent so it could serve as a windshield through which the pilot could see while flying under contact conditions and in bad weather provide an easy to read synthetic information display. The special transparent film developed by the Naval Research Laboratory for this tube will also provide a commercial television picture capable of a sharp, clear picture in broad daylight as well as a simpler, more efficient tube for color television. Several television manufacturers expressed immediate interest in utilizing this process.

Value Engineering

There is another important advantage to be gained through the close cooperation of the military and industry. Both of us are concerned over the large amounts of money required to translate theory into practical achievements. This is particularly true in the field of electronic developments. This is an urgent problem for the Navy because electronics is now a substantial, if not major, part of the cost of a combat ship or aircraft, and that figure is steadily increasing. Navigation, fire control, communications, the detection of enemy aircraft and submarines, guidance systems for missiles—all involve electronics. We span the entire electronics field—in depth as well as width.

What this means is that unless we can combine forces to push electronic costs downwards, we shall one day place upon the shoulders of the taxpayers—who include you and me—the final straw that will break their backs. Fortunately, there are ways of sharply cutting these costs if we but expend the effort to utilize them. One of the principal means is simply to decide when something is just good enough for the particular job to be done. The Navy, following the lead of an industrial concern, namely General Electric, has embarked on such a program. Developed by the Bureau of Ships, we call it value engineering. I know that the AFCEA is aware of this program and its potential for producing efficient and reliable electronics equipment that is less complex and less costly.

The Navy, however, cannot do the job alone. We can lift one end, but industry must lift the other. The fact

of the matter is that the military engineer in designing a piece of equipment and preparing its specifications is not in a favorable position to foresee its high cost and overcomplexity. This does not become apparent until the contractor actually begins to form the physical product. What we want is the contractor, before he begins production, to tell us what it will cost and how complicated it will be to produce what we are requiring. In effect, what we are trying to do is to develop the concept that the manufacturer is part of a defense team, working with the military to develop a design which is reliable, simple, and does the required job without excessive cost—a design we can all be proud of.

Making Progress

Part of the Navy's contribution is to analyze simply the intended use of an item of equipment. Right away this can cut at least ten percent off the price tag. We had hardly gotten our feet wet in the electronics phase of our value engineering program before we ran into this example. A type of Navy radio receiver includes a filter, a crystal calibrator, and a complicated arrangement for displaying the dial readings, none of which is necessary. The filter, because it is designed to handle a power supply ranging from 50 to 400 cycles, costs $104. We discovered that this receiver is never used in locations with varying power requirements and that the commercial 60 cycle filter, which we can buy for $2.50, would be perfectly adequate. The calibrator also proved to be unnecessary because its function is performed by several other pieces of equipment on the ship. The dials are lit up by means of a lens reflecting a pilot light off a mirror back onto a frosted glass. This Rube Goldberg contraption costs $200. Here is something that industry could have warned us about in advance. A simple ordinary pilot light would serve the purpose nicely. In fact, the built-in spare pilot light in this equipment is no more than that. The total savings on these items would be $385. When you consider that there are about 5,000 of these receivers in use, that's a savings of nearly $2 million.

When you add to this what can be saved by redesigning the equipment, our value engineering people estimate that 30 percent of the original cost could be sliced off. This would not be unusual but typical of what value engineering can accomplish in electronics. I might add that the Bureau of Ships program, which began in April 1954, reduced shipbuilding costs during its first year by several million dollars, and that does not include electronics equipment.

I believe that the benefit to the Navy and the taxpayer is obvious, but the program is also directly rewarding to industry. Take the case where progress brought about by research was being thrown away until value engineering came along. As many of you know, our early World War II electronics equipment was made of organic materials that required fungicide spraying to prevent growths. Research gave us new inorganic materials, but no one changed the specs that required spraying. The manufacturers were unhappy because the spray got into the wiring and was causing excessive rejects. No one thought to change the specs, until value engineering demonstrated that the spraying resulted in a loss to the Navy of $350,000 a year. That did it.

Actually, the Navy has already received encouraging indications of support from industry. Several electronics firms have recently inaugurated value engineering programs of their own. A few months ago Dan Noble of Motorola wrote the Bureau of Ships that its program appeared to him to be a hard-headed, constructive, common-sense approach to the solution of some of the design, development and production problems which are created by a degree of arms-length specifications and contracting approach. He also notes that this must be a "shared responsibility." He feels that "the implementation must come from the services, and full cooperation from industry will support the program."

This meeting of minds is gratifying. It means that instead of getting further bogged down in the morass of mounting costs and deepening complexity, we can pull at least one foot out of the mud.

Everything costs money these days, including basic research which can hope to get only so much as its share of the defense pie.

If defense costs can come down—or at least no longer continue to shoot up—then everyone will benefit. Basic research certainly cannot afford to be given a smaller share. Without it, our progress would slow to a crawl. It's not just our problem, it's your problem as well. But with the right attitude and the right approach, I think we will have it well in hand. After all, as citizens, what we want is a strong defense, at minimum cost, with honor and reasonable profit.

Industrial Luncheon

DEFENSE

Research and Engineering

James M. Bridges
Director of Electronics
Office of Asst. Sec. of Defense

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The theme of this National Convention, "Marconi to Mars," is possibly a little premature, but it is nevertheless quite appropriate. It is certainly symbolic of the fantastic things now being accomplished through application of the technology of electronics.

I don't think we have yet established two-way radio communication with the Martians, but it must be because they are not cooperating. Our research and experimentation in the field of radio astronomy should at least have let the little green men know we are here. Surely, the Man in the Moon knows, and so do the meteors blazing their way down through the centuries, because for some time they have been used as "electronic backboards" for our researches into extending communications beyond the limited horizons imposed by the physics of our own planet.

On that day in 1898 when Marconi realized that he had successfully established the first wireless communication circuit in history, I wonder what his thoughts would have been if he had been able to foresee the tremendous impact of his pioneering accomplishment upon civilization within only 60 years. He would undoubtedly have felt mixed emotions, had he realized that the extension of the same basic principles of electromagnetic propagation by which he transmitted intelligence across the English Channel would, in the lifetime of his own children, have such a profound influence upon the advancement of civilization but, at the same time, would provide the potential means for the virtual destruction of that civilization during the darkness of a single night.

A few years ago, it was my privilege and pleasure to act as host and guide to a group of British Naval officers who were visiting this country to review our research and development programs in electronics for application to weapons control. In connection with this mission, we visited a representative cross section of Government laboratories and industrial concerns working in this area and in allied fields. Near the end of our tour, one of the companies demonstrated a new radio transmitter that was being developed for our Navy—a very complex multichannel device with remote control and literally jammed with relays, stepping switches and tubes. After studying the equipment in some detail, one of the British officers casually remarked, "I say, the wireless has a bloody lot of wires these days."

This expressive remark is most pertinent to the situation that today exists across the board in military electronics. Our electronic devices have become exceedingly complex, and in practically every modern defensive and offensive weapons system we do have a "bloody lot" of wires and electron tubes.

Electronic Defense

During the brief span of years since the beginning of World War II, this relatively young technology which we call "electronics" has come to play a vital role in our national security. In less than a quarter-century, electronics in military operations has expanded from its first relatively simple application in radio communications to its present status as a basic ingredient of navigation, target detection, identification, threat analysis and weapons control. The annual military expenditure for electronic equipment and systems is approaching four billion dollars. In 1937, a Navy destroyer's electronic equipment contained about 100 vacuum tubes and a bomber aircraft about 30. Today, the various equipments in a destroyer use well over 5,000 tubes and the bomber, almost that many. In a single location, over 50,000 electron tubes are employed in the electronic systems now being installed for the defense of the continental United States against air attack.

As a result of this phenomenal growth and technological advance in military electronics, the intricacy of equipment and systems has constantly increased. Our imaginations may have run away with us at times when we created devices that were unnecessarily complex. Nevertheless, we must face the facts and recognize that complicated weapons and weapons systems are needed to maintain our national security and that their complexity will progressively increase.

A guided missile system is a good example of this enormous compounding of complexity. A single, long-range, surface-to-air guided missile may require the integrated application of a long-range detection radar, an acquisition radar, a tracking radar, computers, a guidance transmitter and complex communication, display and control devices on the

ground, all functioning together in precise relationship with the missile-born electronics, which include a radio receiver, a computer, a homing device, an auto-pilot and a fuze. Every element of this extremely intricate system has requirements of performance and environment that push to the limit the capabilities of the present state of the electronic art.

But this and other guided missile systems are absolutely essential to our national defense. The gun systems, which are rapidly being replaced by guided missiles, were considerably simpler, but they are no longer effective against the high altitudes and speeds of modern military aircraft. We are very fortunate that, through its technical and industrial resources, this country has been able to develop and produce these complex missile systems in time to keep our defense on top of the advances in aircraft performance. Scientists and engineers in electronics have had the toughest job in these missile developments, and they can be very proud of their accomplishments. Tremendous credit is also due to the officers and civilians in the Services who had the vision and the courage to undertake and carry on the early guided missile developments in the face of almost insurmountable problems of technology and funding.

The Challenge

As complicated as these guided missile systems are and as costly and difficult as their development was, these factors are relatively minor when compared with those of some of the weapons and weapons systems now being planned or developed for future use. And this brings me to the main topic of my discussion: How can we, in the military services and in industry, meet the challenge of advancing our electronics technology rapidly enough to fulfill the urgent requirements for these new weapons and to develop, engineer and produce them in time to maintain our weapons superiority?

To all of us who are concerned with research and engineering in the area of military electronics, this is indeed a very great challenge—and we cannot afford to fail. The technical problems are staggering; their solution will call for a greatly increased effort in electronics research and development. We can be confident of our ability to meet the challenge successfully; this country has the greatest and the most progressive electronics industry in the world, and our scientific and engineering talent in this field is second to none. Even so, I must emphasize that we can fall far short of the goal unless we use our great technical capabilities in the most economical and effective fashion.

Rising Costs

It does not appear that the level of defense appropriations will be appreciably increased during the next several years. Secretary of Defense Wilson has stated on several occasions—and I think most of us will agree—that the present level of defense expenditures is about all that the military and civilian economy can tolerate and still maintain its sound structure and balance. Although some increase in defense appropriations may be possible as the national wealth advances, it would hardly be to a significant degree over the next few years.

If this assumption is correct, we face a very serious problem in developing and making available the advanced weapons that we need to maintain our military superiority—even our equality. The cost of developing these complex equipments and readying them for production has risen sharply; for the electronic portions, the cost has skyrocketed to the highest level.

Much of this increasing development expense is due to greater system complexity, higher salaries, rising prices of materials and the continual compression of time scales. But the cost of electronic development has increased so terribly over recent years that we cannot really account for it on the basis of these changes alone. I am convinced that there are other factors associated with our methods of planning and managing military research and development that contribute significantly to the rising costs. If this country is to stay ahead in weapons development without going into bankruptcy, we must find ways to be more economical in the conduct of our programs.

I wish to make it quite clear that I intend no criticism of either the military departments or industry in this respect. All our efforts have been so concentrated on trying to solve the tremendous technological problems associated with these new developments that we have not had the time to dig into the intangible causes of the fearful increases in cost. But the situation is becoming so serious that we must now take the time to study this problem carefully and objectively.

A major portion of the cost of research, development and engineering is reflected in technical effort. So when we talk of skyrocketing research and development costs, we really are speaking about vastly increased numbers of engineering man years. Because our supply of scientists and engineers is limited, the availability of technical people to do the work may represent an even greater problem than the actual dollar cost in carrying out our future development programs. It is even doubtful that the availability of substantially more dollars for electronic research and development would significantly increase our developmental capabilities, because it would only tend to super-saturate our already saturated technical resources. This constitutes a further incentive and justification for a careful analysis, by both the military departments and industry, of the management of military research and development to determine what steps can be taken toward better economy and more effective utilization of technical manpower.

Problem Studies

Many people in the military departments and in the Office of the Secretary of Defense are extremely concerned about these interrelated problems of cost and technical manpower utilization. On March 16, 1957, the Secretary of Defense, recognizing the seriousness of the problem, established a committee to study the extent to which current policies and procedures concerned with the design and development of military materiel impair the efficiency of technical manpower utilization in the industries serving the Department of Defense. The responsibility for forming this committee and directing its activities has been assigned to the Assistant Secretary of Defense for Research and Engineering.

The objectives of this newly formed committee were stated by Secretary Wilson in a recent memorandum to the secretaries of the three military departments and the interested Assistant Secretaries of Defense as follows: "The study should encompass those problem areas in which corrective action can be expected to promote the most efficient use of technical manpower in the execution of design and development projects and programs. Among the items which the committee should consider are: *Engineering Records,* particularly requirements imposed on industry for drawings and specifications which lead to ineffective utilization

of technical manpower in design and development. *Contractual Practices* involved in the selection of design and development contractors by bidding and other methods which tend to dissipate technical manpower resources in industry. *Technical Administration of Design and Development Contracts* to include the wide variances that exist in industry in the use of engineers and other technical people on similar projects or contracts and the extent to which technical manpower is wasted by unrealistic classification and processing of engineering changes."

You can appreciate the magnitude as well as the intangible nature of the problem areas involved in this study. While it is expected that some of the problems can be solved by revising certain policies and procedures within the Department of Defense, the achievement of major economies in the use of research and development resources will require an earnest and wholehearted endeavor on the part of American industry.

Although I have emphasized the need for more economy in the use of our research and development dollars and technical manpower, I don't want to leave you with the impression that this is our only research and development problem in the area of military electronics. Having the money and engineers to do the job ahead of us is only the means to the end. Even then, we face a most difficult task in advancing electronic technology on many fronts to meet the new demands.

Requirements

During the past decade, weapon developers have been withdrawing from our "bank account" of basic electronic technology much faster than we have been replenishing it. In fact, it has been necessary in recent years for those engaged in system developments to sponsor research and development on tubes, component parts and basic electronic techniques. This has resulted in lengthened time cycles for weapon development, compromises in desired weapon performance, duplication of research and development efforts and a serious departure from the principles of standardization.

It is essential that research and technical development effort in the area of electronics be substantially increased if the demands of new system developments are to be met on a timely and economical basis. For reasons of security, I cannot state specifically where this increased effort is most urgently needed, but I can say that significant advances are required in many areas of electronic components and technology, and we must have breakthroughs in some.

Considerable progress in fundamental electronic research is being made in Government, academic and industrial laboratories. Nevertheless, the fruits of these efforts must be more specifically directed toward military applications through a coordinated and intensified program of applied research and technical development.

As I have already pointed out, it is very costly—in many cases, wasteful—to perform this applied research and technical development in connection with system developments. To be effective, this work should be planned, funded and executed apart from specific weapons system programs, but it must fully consider the requirements of these system programs.

Reliability

More money will be required to establish and maintain an adequate research and technical development program in the area of electronics, but these funds must be made available even if they must be obtained from the appropriations for weapons and weapons system development for production. Those people in the Government who are responsible and have the authority for appropriating defense funds should realize that in electronics we have the basic building blocks for all weapons and that, unless sufficient money is made available to improve this fundamental building material, advanced weapons developments may not be possible. We cannot build tomorrow's weapons with today's electronic components and technology.

Thus far, I have emphasized the need for more economy in the expenditure of funds and technical manpower in carrying out military research and development programs, and I have presented the requirements for more research and technical development effort in electronics to meet the demands of advanced new weapons and weapons systems.

To these are added further problems. On the less glamorous side, we must find the answers to some mighty tough engineering questions too. You know that we have been working very hard, both in the military services and in industry, to build enough reliability into our military equipments and systems to make them effective in service. In this we have been making excellent progress, but the job is going to get much tougher as our systems become more complex and as we press farther into areas of new technology. So, in the future, we will have to place even greater emphasis upon reliability engineering.

Still on the engineering side, we urgently need much more effort in the areas of standardized design methods, designing for automatic manufacturing processes, obtaining better and more reliable tubes and components parts and improving our general engineering specifications and practices.

Seeking Solutions

I shall now summarize the major problems confronting industrial organizations and the Department of Defense in the area of military electronics. First, with respect to the skyrocketing costs of electronic development and engineering, we must determine the causes for this serious situation and immediately take corrective action.

Next is the question of successfully carrying out essential research and development work in the face of a technical manpower shortage. We must make sure that the services of every scientist and every engineer working on military programs are being utilized for maximum effectiveness.

The third item to be considered is the real, fundamental problem of advancing our basic electronic technology fast enough to meet the requirements of new weapons and weapon systems. To do this, we must put more emphasis and more dollars on applied research and technical development.

Certainly not the least of our problems is that of achieving the excellence and maturity of engineering that is needed to make our new weapons and systems acceptably reliable for service use and ready for production in the quantities required for mobilization.

The solution to these problems can be accomplished only through the combined and cooperative efforts of industry and the military services and by the most effective teamwork between our scientists and engineers. It is our challenge that we must resolve these questions in time and successfully to reinforce and strengthen the future security of this country.

I feel sure that, in seeking solutions to these critical problems, the Armed Forces Communications and Electronics Association can and should play a vital and inspiring part.

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A vital product need just ahead on the horizon, lies in the field of INFRARED*. For detection of any potential aggressor, Hot stuff* comes through! IR* has numerous significant advantages: target size is not critical... a passive seeker, it never divulges its source or location... will outperform radar of comparable dimensions. IR can't be jammed... when detecting, it can't be detected. LMEE... pioneering these advantages... has the research and production facilities to make all this a protective reality today. Its Advanced Electronics Center at Ithaca, New York, has an INFRARED Projects Group staffed by recognized authorities on IR development. INFRARED by LMEE... with its broad applications to Airborne Weapons Control Systems... is another LMEE contribution to new uses of Defense Electronics. For information on IR ... write Section D.

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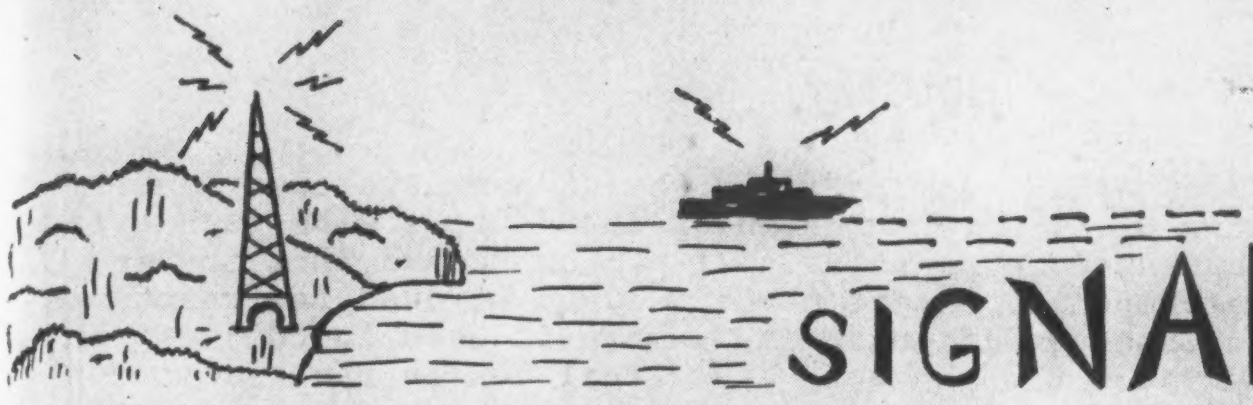


SIGNAL·GRAM

— GOVERNMENT —

TV PROGRAMS TRANSMITTED TO CUBA The FCC has given the go-ahead for inauguration of overseas telecasting by authorizing the first use of "over-the-horizon" program broadcasting. AT&T and Florida Micro Communications, Inc., Miami, both received permission to transmit ultra-high frequency television programs between Florida and Cuba, a distance of 180 miles, via the tropospheric scatter technique.

PARACHUTES UTILIZED FOR TALKING TO THE ENEMY Air Research and Development Command (ARDC) has announced a new parachuting public address system as an aid to talking the enemy into surrendering. The development, nicknamed "Talk Down," is for the use of psychological warfare units trying to get enemy troops to give up. This bomb-shaped device goes "on the air" at 4,000 feet with a tape recorded message about 250 times louder than that of an average TV set. Instead of hovering over the area with a loud speaker which is risky under ground fire or bad weather conditions, they can now drop their peace appeals from high altitudes. The system was developed on an inter-service and industry project monitored by ARDC's Wright Air Development Center. Cook Research Laboratories, Skukie, Illinois, has the development contract.

BALLOON RECORD SET IN MINNESOTA In June, Capt. J. W. Kittinger, Jr., a jet pilot, rode a huge plastic balloon to a record 18 miles high, beating the old manned-balloon mark by four miles. Kittinger landed safely in the helium-filled bag, suspended in a 3 by 7-foot gondola, after soaring to 96,000 feet for one hour and 50 minutes. Total flying time was six hours and 34 minutes. The test was cut short when the voice transmitter failed on the way up due to antenna trouble. This ascension, one of a series, may prove valuable in future rocket and manned-satellite flights. Later this summer the Air Force will attempt a manned-balloon flight to 100,000 feet to remain for twenty-four hours.

"ROBOT" TRACTOR AT FORT BELVOIR A tractor that can be operated anywhere within range of the radio by which it is controlled is undergoing tests at the Army Research and Development Laboratories, Fort Belvoir, Va. The tractor, believed to represent the first application of the remote control principle to construction equipment, may prove invaluable in construction work in radio-activated and combat zones and in fighting large fuel storage fires. From a jeep or helicopter equipped with a standard military radio transmitter and a special control box, normal operations can be performed from distances up to 15 miles, simply by manipulating the buttons on the control box. By mounting small television cameras on the tractor, it is believed that the remote operator could manipulate without any information from a visual observer.

CONTRACT AWARDS: The ARMY has announced the following contracts: Servo Corp., development of a high accuracy direction finding set (AN/TRD-15), $143,563; Chrysler Corp., guided missile components, $3,782,738; Chrysler Corp., 900 M48-A2 Tanks, $119,000,000; Collins Radio Co., 12 radio transmitting sets (AN/FRT-22) and 4(AN/FRT-26), $1,137,225. NAVY grants include: Sperry Rand Corp., super-radar used to guide anti-aircraft TERRIER missiles toward targets (SPQ-5), $51,550,398; General Electric Co., development of T64 gas-turbine engine, $58,500,000; Eastman Kodak Co., production of VT fuses, $3,000,000; Northern Ordnance, Inc., TERRIER launching equipment, $20,000,000; Hercules Powder Co., testing of experimental missile propulsion systems, $3,500,000; Aerojet General Corp., JATO units and spare igniters, $3,500,000; Elgin National Watch Co., guided missile SIDEWINDER fuzes, $700,000. The AIR FORCE awarded contracts to: Page Communications Engineers, Inc., design, procurement, installation and test-operation of scatter communications systems for SHAPE, $3,500,000; Lockheed Aircraft Corp., continuation of ramjet engine flight test program, $14,500,000; Hughes Aircraft Co., modification of airborne electronic control systems used in all-weather jet interceptors, $1,071,239; Boeing Airplane Co., Bomarc missile, $7,109,195.

— INDUSTRY —

SENSITIVE CAMERA OPERATES UNDER WATER Admiral Corporation has developed a new military television camera for the U. S. Navy's Bureau of Aeronautics with such extreme sensitivity that it can be operated under water. It was announced that special circuitry in the new image orthicon TV camera permits it to be used for reconnaissance even under the most adverse conditions. The camera is used in conjunction with a television monitor on which the phase of the signal can be reversed and the picture size can be controlled.

NATO TO BE LINKED BY FORWARD SCATTER COMMUNICATIONS SHAPE has issued a letter of intent for the engineering and installation of one of the most modern and extensive military communications systems in the world. This new network will combine over-the-horizon tropospheric forward scatter and line-of-sight radio relay links extending from Eastern Turkey around the broad crescent throughout NATO Europe to Northern Norway, with its main center in Paris, France. This estimated $9,000,000 contract was signed by International Standard Electric Corp., the overseas management subsidiary of IT&T and Hycon Eastern, Inc.

RADAR AIDS IN THE KITCHEN Scientists at Raytheon Manufacturing Company's Food Laboratory are using radar's electronic energy to preserve fresh and cooked foods so they can be stored on a kitchen or grocer's shelf at room temperature indefinitely without refrigeration, and without loss of flavor, texture, or nutrient value. The preserved food weighs only a fraction of the fresh product. From 70 to 95% of the fresh foods' weight is water, which is removed by applying microwave energy while the food is held under vacuum at below freezing temperatures. The food can be restored to its original fresh condition in minutes simply by immersing in hot water. Still in the laboratory stage, this "freeze-drying" process has tremendous potentialities for the military in their supply problem—on the sea, in the air, and on the ground.

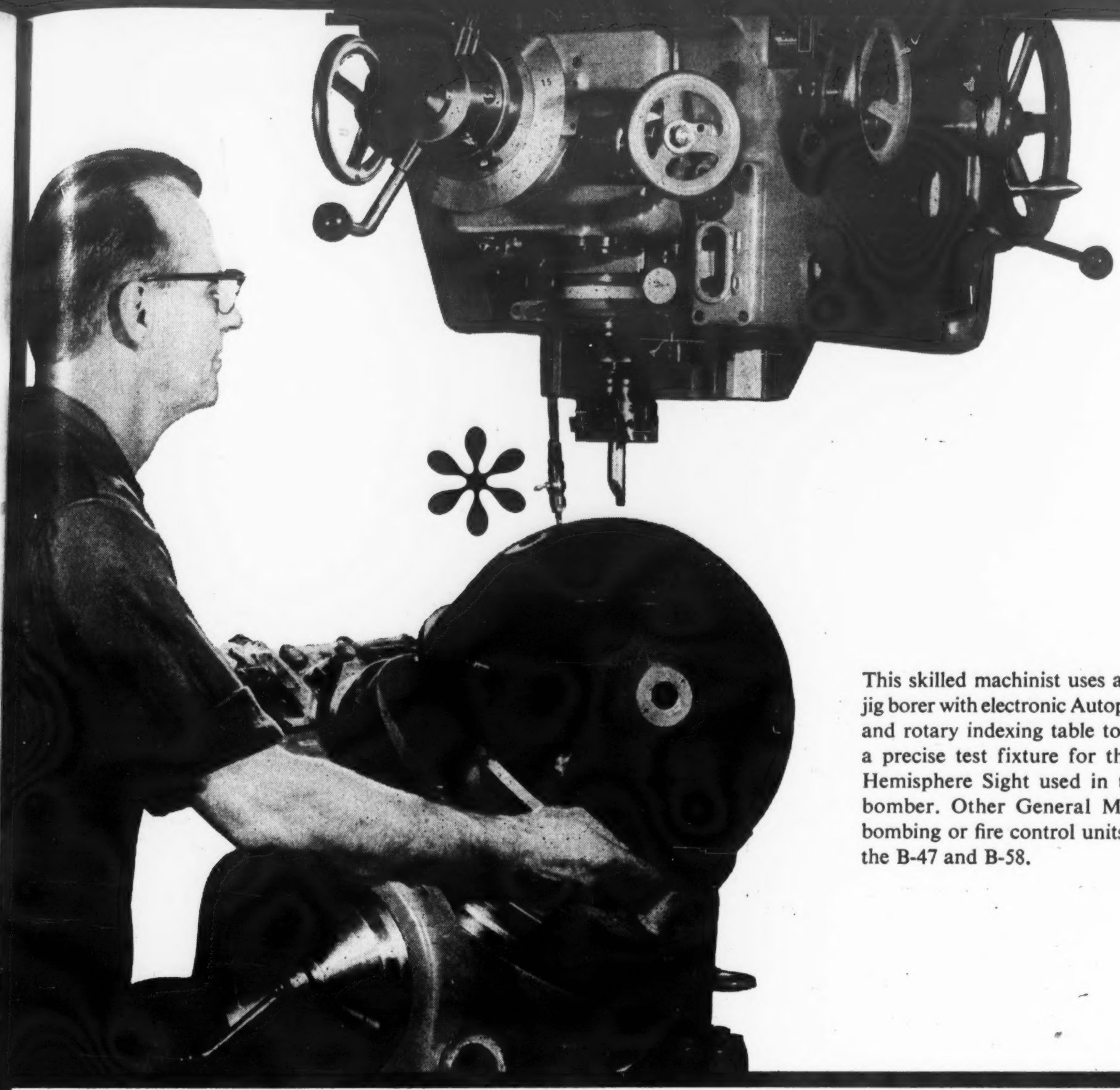
THE TOUGHEST METALS KNOWN TO MAN A new furnace, pioneered in titanium melting and described as "a major metallurgical breakthrough," is being made available in the metals industry. This announcement came from Titanium Metals Corp. of America, Allegheny Ludlum Steel Corp., and the Lectromelt Furnace Division of McGraw-Edison. The furnace, called a consumable electrode vacuum remelting furnace, melts titanium, zirconium, high alloy steels, or other ferrous or non-ferrous alloys which are remarkably free of impurities. Such high-performance metals are used in building jet aircraft and engines, missiles, and atomic reactors. One official said the precision low-cost melting technique was in great part responsible for advancing titanium to a tonnage metal at constantly lower price levels.

— GENERAL —

RADIO AMATEURS TRANSMIT A "FIRST" The first successful transmission of sports pictures and Sunday comics to the Antarctic was made on Sunday, May 5, via radio facsimile. The transmission was accomplished by radio amateurs in the U. S., more than 8,000 miles from the point of reception. The pictures were transmitted to the Antarctic by W2KCR at North Syracuse, N. Y., and the Operation Deep Freeze Committee of the Radio Amateurs of Greater Syracuse as a function of the American Red Cross Amateur Radio Morale Message Service. The new radio picture transmissions are a forecast of similar and more personal transmissions in the future.

U.S. AND PORTUGAL LINKED BY DIRECT TEX CIRCUIT RCA Communications, Inc. has announced the opening of a direct radio-teletypewriter exchange service (TEX) between the U. S. and Portugal. The new point-to-point circuit provides increased capacity for handling the two-way TEX calls made by business-men. Now, circuits to Holland and France, over which Portuguese TEX traffic was routed previously, are able to carry heavier volumes of calls, and calls between Portugal and Japan, Hawaii, or the Philippines will all be processed more rapidly. Rates for TEX service between the U. S. and Portugal will remain at $3.00 a minute for a three-minute minimum call.

"ELECTRONIC EQUIPMENT" RECEIVES RECOGNITION The International Telephone Directory, a worldwide classified business phone directory, will have a special section under the general classification of "Electronic Equipment" in its third edition which is slated to be published January 1958. Sub-classifications bearing the prefix "electronic" are as follows: "Engineers," "equipment designers," "industry," "measuring and testing devices," "research," "tubes and equipment," and "tube-machinery manufacturers."



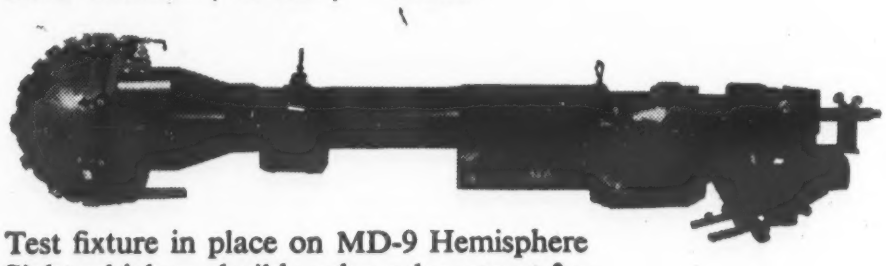
This skilled machinist uses a Lindner jig borer with electronic Autopositioner and rotary indexing table to produce a precise test fixture for the MD-9 Hemisphere Sight used in the B-52 bomber. Other General Mills-built bombing or fire control units fly with the B-47 and B-58.

*B-52 gunners are better marksmen because of this General Mills craftsman

Maintaining accuracy of the MD-9 Hemisphere Sight for the tail defense system in B-52 bombers calls for unusually close tolerances. Holding these tolerances requires exacting test fixtures. We designed, engineered and built many of them.

The optical device in the picture has flat, microfinished surfaces with angular accuracy within two minutes of arc surrounding lens openings. The critical flat areas and openings are located from bearing holes that are held within +.0002″, −.0000″.

We'd like to tell you more about how we combine creative engineering and fine precision production to serve industry and military. Our unified team can handle research, development or manufacturing—or the whole package. Send for facts, Dept. SG7



Test fixture in place on MD-9 Hemisphere Sight which we build under subcontract for the Crosley Division of Avco.

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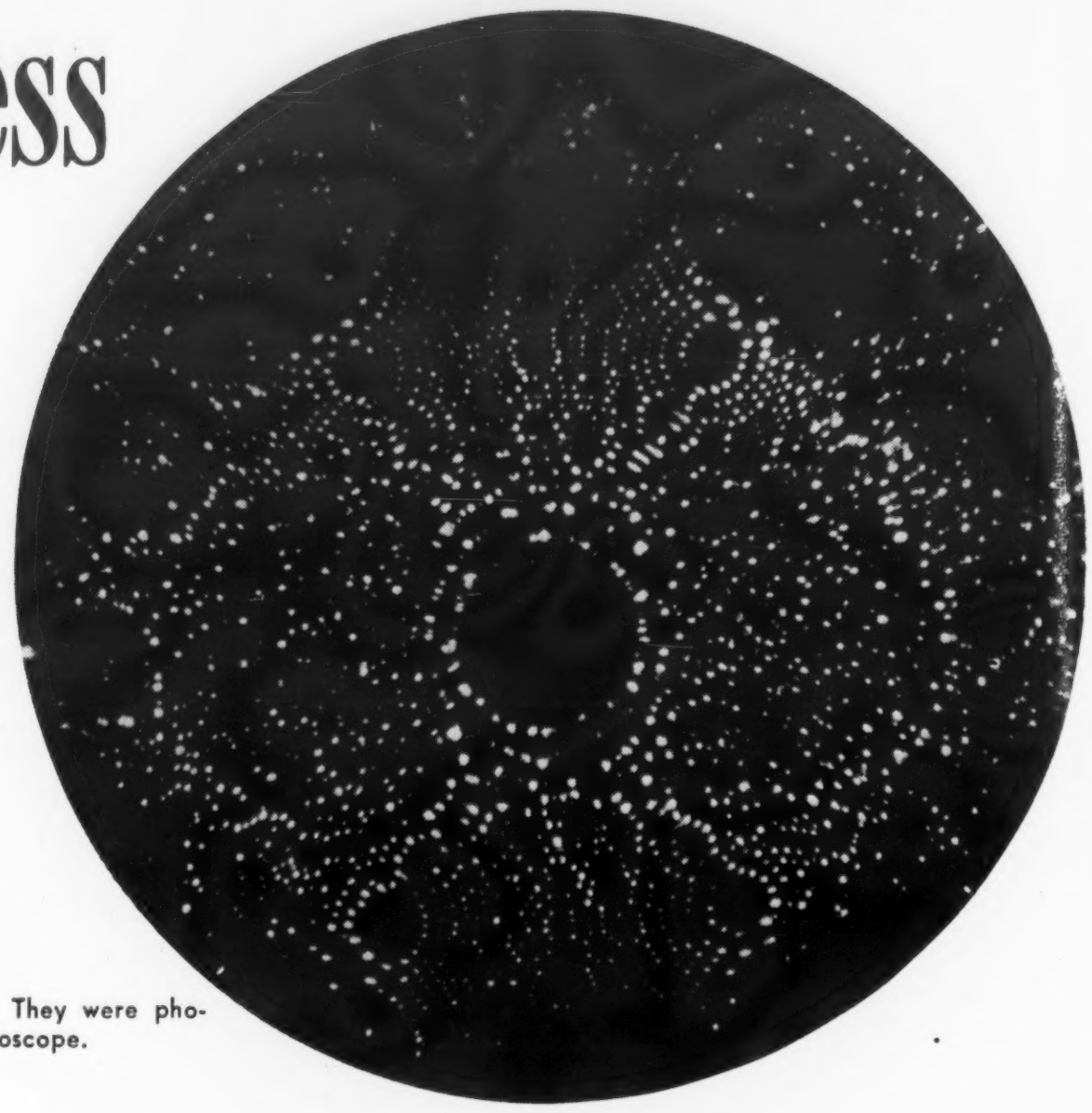


The white dots pictured here are tungsten atoms. They were photographed by means of the field ion microscope.

by FRANK SMITH
PHOTO EDITOR
SIGNAL

Photography Of Atoms

Photographers interested in the photography of particles too small to be seen by the most powerful microscope will doubtless be interested to know that photographs of individual atoms of tungsten, rhenium and some other metals, have been made by means of the field ion microscope developed by Dr. Erwin Müller of Pennsylvania State University, University Park, Pa.

The field ion microscope is an improved version of the field emission microscope which was invented by Dr. Müller some years ago.

Briefly, the field emission microscope consists essentially of an evacuated glass envelope which is shaped somewhat like a small TV tube. Leading into the glass envelope are two current carrying wires which terminate in a very fine point and form the emitter (cathode).

The inner surface of the tube is coated with a conducting film which forms the anode.

The viewing screen is formed by coating the inside convex face of the tube with a phosphor powder which produces visible light when electrons or ionized atoms impinge on it.

In operation a negative potential of several thousand volts is applied between the cathode and anode. A visual image of the lattice structure of the cathode tip then appears on the phosphor viewing screen.

In the field emission microscope, the emitter tip is charged negatively, whereas in the field ion microscope, the emitter tip is charged positively. The positive ions which form the image are made from a thin gas of helium atoms introduced into the microscope.

In contrast with the electron microscope which gives a resolution of about 10-20 angstrom units, the field ion microscope gives a resolution of the order of three angstrom units and since atomic dimensions are of this order. they can be resolved. Magnification is of the order of two million and the images produced are bright enough to be recorded by sensitive film with an exposure time of one minute.

Professor Müller has worked out a color print technique by means of which changes in the atomic structure between pictures taken at different times may be shown. For instance, a copy of the first picture is illuminated by green light and a copy of a second almost identical picture is illuminated by red light. The two pictures are brought to coincidence by optical means and the resulting picture is then photographed on color film. In the resultant picture, all atoms that occupy identical positions on both photographs appear bright yellow, the ones that are only on the first picture appear green and the ones that are only on the second picture, red. The color pictures are quite striking and allow one to view the distribution of the loosely bound atoms over the crystal hemisphere.

The field emission microscope is expected to play an important part in studies of certain properties of metals such as fatigue, creep, evaporation, etc.

New Air Force "Cat Eye" Light Amplifier

According to the Office of Information Services, Air Research and Development Command, Baltimore, Md., a new light amplifier called the "Cat Eye" may provide the means for answering the questions about the "canals" on the planet Mars.

The "Cat Eye," which grew out of a research program of the Air, Research and Development Command under the sponsorship of ARDC's Aeronautical Research Laboratory at Wright Air Development Center (WADC), Dayton, Ohio, can see a scene at night and reproduce it with daylight brightness, even when the human eye can see nothing. Research work on "Cat Eye" light amplifiers was conducted for ARDC by Westinghouse Corp.

and the Radio Corp. of America.

Conventional photographs of planets and other heavenly bodies taken even with the best telescopes suffer from the "jitters." The "jitter" is caused by tremors of air masses in the earth's atmosphere which affect the resolution of distant objects such as planets and galaxies, because the light is deflected first in one direction and then in another. An example is the shimmering of starlight seen on a clear night. This shimmer causes the photographs to blur, since conventional photographic techniques require exposures of several seconds for Mars, and even longer periods for more distant planets or the stars.

In operation, the "Cat Eye" light amplifier senses and amplifies the always present light unseen by the human eye. Photons, the electro-magnetic waves which appear as light over certain frequencies, are sensed and imaged on a photosensitive surface. There they are transformed from photons to electrons, accelerated, and produce electro-static images. These are further amplified and are sensed by an electron beam. The resultant signal again is amplified into the cathode ray tube.

Photographic exposure times can be reduced 16,000 times with the light amplifier, according to Mr. Radames K. H. Gebel, of WADC's Aeronautical Research Laboratory. This will permit photographs that might reveal the nature of the "canals" and other features of Mars, and also make it possible to see perhaps 100 times farther into space than with the finest telescopes using conventional photography.

The WADC's Aerial Reconnaissance Laboratory is planning integration of the "Cat Eye" into reconnaissance systems which can take aerial pictures at night.

Electron-Image Recording by Xerography

An interesting method of using Xerography for the purpose of recording of electron images of the type produced in electron microscopes and electron diffraction cameras is described by P. B. Sewell in the April 13, 1957 issue of *Nature* (London).

Sewell states that by using an accelerating voltage of 50 kv., electron diffraction patterns have been recorded on vitreous selenium films about 60 microns thick, developed for use with X-radiation.

A limited number of experiments has shown that, using 50 kv. electrons, the particular selenium plates employed require an exposure similar to that used with Ilford N. 50 photographic emulsions.

A diffraction pattern just visible on the fluorescent screen requires an exposure time of about five seconds.

The author states that the following points are of particular interest with regard to the possibility of using the technique to record electron images:

(1) The vitreous selenium plates are free from outgassing effects at room temperature,

(2) Xerographic plates of the type developed for radiography can be used for recording electron images produced in electron optical instruments using beam accelerating voltages between 45 and 55 kv.,

(3) Such plates require an exposure similar to that used with the high-contrast photographic emulsions commonly employed in electron microscopy and electron diffraction,

(4) The use of suitable liquid developing techniques makes possible image resolution beyond the limits attainable with conventional photographic materials, without sacrificing the plate sensitivity,

(5) The high image-contrast and wide latitude of exposure that have been demonstrated with Xeroradiography could be advantageous in the recording of electron microscope images, which frequently exhibit low relative contrast.

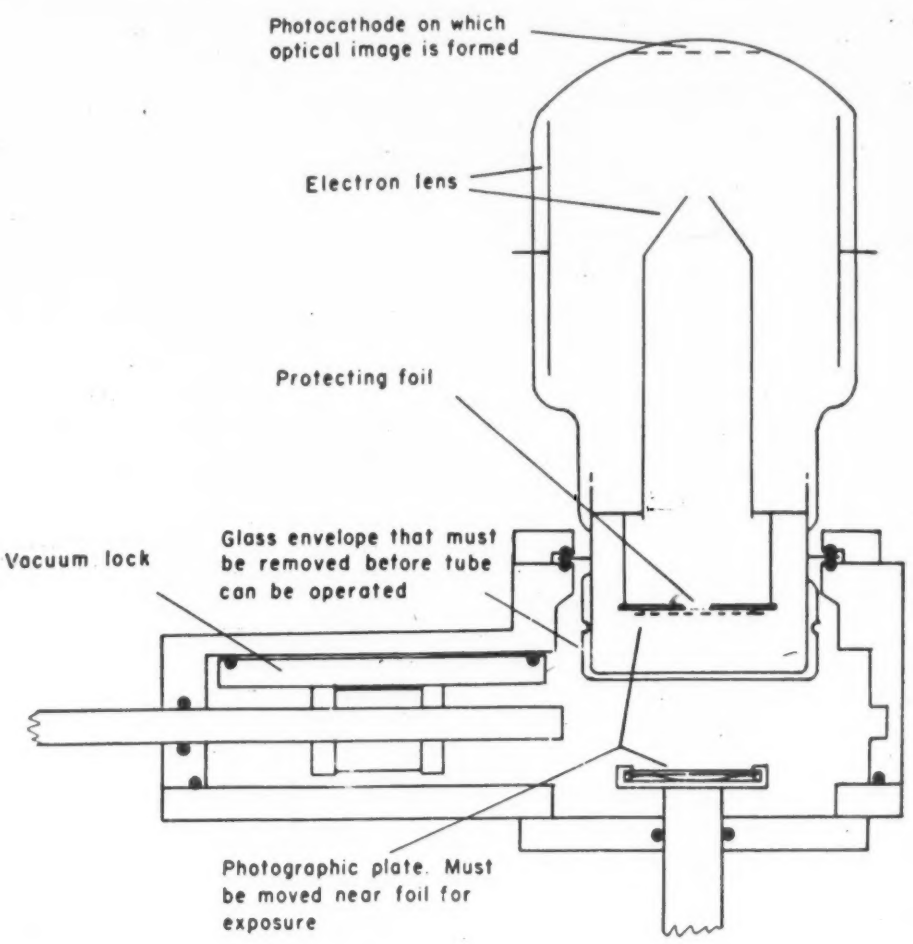
Your author has long thought of the idea of a truly electronic camera for ordinary use wherein the light or optical image of a scene is picked up by an image tube and converted into an electron image which is instantly and directly recorded by electronic means as a dry photograph, thereby doing away with the conventional silver halide film with its attendant chemicals, darkroom and processing.

Sewell's experiments seem to indicate that such a camera may not be beyond the realm of possibility.

Image Converters in Photography

One of the interesting developments in recent years is the increasing use of image converter tubes in the field of photography and particularly in high speed photography. However, it is not alone in the field of high speed photography that these tubes are useful, but also in astronomy for direct photographs of star fields and stellar spectra.

Although it may not be so well known, it has been amply demonstrated that the information recorded per unit time by a photographic film can be greatly enhanced by exposing the emulsion to accelerated photoelectrons instead of photons. In order to do this, an image converter must be used and the film must be placed inside the converter. Since the film contaminates



The above is a schematic diagram of the Hiltner image converter tube with protecting foil and plate changer. In recent years, use of the image converter tube in high speed photography has increased. These tubes prove valuable not only in the field of high speed photography but also in astronomy for direct photographs of star field and stellar spectra.

or poisons the photocathode and shortens its life—perhaps to the order of one hour—a method had to be found to overcome this. W. A. Hiltner of Yerkes Observatory, Williams Bay, Wisc., under a contract sponsored by the Office of Ordnance Research, U. S. Army, has experimented and demonstrated an ingenious method of doing this by inserting a thin metal foil between the photocathode and film. The foil has the property of transmit-

ting the electrons but holds back the contaminates (water vapor) of the film. Thus, an effective barrier is set up.

The image converter was made by the Farnsworth Electronics Corp. and is a modification of a standard image converter with the phosphor replaced by a thin aluminum foil.

Other workers, notably Professor André Lallemand of the Paris, France, Observatory, use converter tubes constructed along somewhat different lines but also with good results. Image converters which are said to be 100 times more efficient than a photographic emulsion for reacting to photons have been reported and the use of this tube for astronomical photography seems to be assured.

Quite a different use for image converter tubes is reported in a paper entitled "Millimicrosecond Photography With an Image Converter Tube" by R. Carroll Maninger and R. W. Buntenbach of Precision Technology, Inc., Livermore, California, presented at the 1957 IRE Convention in New York City.

The authors describe a camera that uses a new type image converter tube which is designed for image control, focussing and deflection by pure electrostatic means as opposed to electrostatic-magnetic means in previous type cameras.

Some applications of high speed cameras such as photography of the growth and decay of electrical discharges, detonation propagation, shock wave formation, etc., require cameras of ultra high speed.

The apparatus described in the paper consists of a specially designed image converter tube, associated pulse circuitry, and oscilloscope recording camera. The use of the image converter tube and its associated circuitry in this camera is unique in that it acts both as a shutter and as a means for moving images across the face of the stationary recording film. The camera can take a multiple framed sequence with controlled time spacing between frames and with exposure times during each frame as short as ten millimicroseconds.

The image converter camera is easily synchronized with the events being photographed and under certain conditions, the camera requires less light from the event than other types of cameras. This results from the ability to obtain light amplification within the image converter tube itself. The image tube used is an RCA Type C73435A with nominal characteristics.

The resolution capability of image converter tubes is customarily referred to the cathode. The authors state that the first six C73435A tubes had a resolution capability of 14 to 28 line pairs per millimeter. This corresponds to some 20 to 40 line pairs/mm on the screen.

The authors further state that considerable success has been achieved with Type 44 Polaroid film, and the convenience and ease of developing this film makes its use highly desirable.

Exicon—Expanded Image Contrastor

The development of a new color X-ray viewer with the exotic name of "Exicon"—Expanded Image Contrastor—that increases the readability of X-ray pictures through the use of contrast enhancement and color TV techniques has been announced by the Philco Corp., G&I Division, 4700 Wissahickson Ave., Philadelphia 44, Pa.

The "Exicon" X-ray viewer performs three essentially different, but equally important, functions to extract quickly and accurately a maximum amount of information from an X-ray transparency, according to Dr. J. Gershon-Cohen, Chief of Radiology of the Einstein Medical Center, Northern Division, Philadelphia, Pa. Dr. Gershon-Cohen, who has been in close contact with Philco, Government and Industrial Division, research engineers during the development of the "Exicon" X-ray viewer, said that the viewer "enhances X-ray contrast in 'gray scale' variations, increases readability by utilizing full color and magnifies an area being viewed."

The viewer consists essentially of monochrome and color monitors, an operator's console and a flying spot scanner. An X-ray negative placed before the flying spot scanner will be magnified and separately reproduced in enhanced monochrome and color. Negatives may be quickly shifted about to obtain magnified images of any portion. The system may be used in conjunction with closed circuit color TV installations.

Before processing the information contained on an X-ray negative through a contrast, enhancing device and a color converter, the information must be transformed into an electric signal. This is accomplished through the use of a flying spot scanner. The heart of this device is a cathode ray tube. By means of a sharply focused, internally generated electron beam, a very small spot of high luminous intensity may be produced on the tube's phosphor screen. This bright spot is then focused by a lens system upon the X-ray transparency under examination.

An amount of light, proportional to the transparency of each small area of the negative, passes through the negative and is picked up by a photo tube. There the light is transformed into a video signal which is then amplified. This signal is then fed to a constant enhancing device in which adjacent areas having a difference in brightness that is hardly discernible, may have their relative contrast enhanced well above the threshold of visibility. This TV signal is now fed to a black-and-white monitor and through a color monitor where the X-ray picture is reproduced in color.

On the color monitor, the strongest signal obtained from particularly transparent sections of the X-ray negative will be portrayed as the color red; the weakest signal will show up as blue. Between the extremes, colors range through orange, yellow, chartreuse, green and cyan. The system has been made sufficiently flexible so that different color sequences may be realized. It is also possible to electronically convert the image from a negative to a positive in an instant.

Other uses for the new system now under study are: aerial reconnaissance, air traffic control and various industrial techniques such as those employed in the fields of metallurgy, chemistry and pharmacology.

New Photographic Science and Engineering Society

One of the signs of the times—particularly as it relates to photography and its advancing use in science and technology—is the recent formation of a new technical group, the Society of Photographic Scientists and Engineers, Washington, D. C.

The new society which has been formed is the result of the merger of the Technical Division of the Photographic Society of America (PSA) and the former Society of Photographic Engineers.

The new society which will consist of some 1,200 scientific and engineering members scattered throughout the world is dedicated to the "application of photography to science and science to photography."

A new official journal of the society to be called *Photographic Science and Engineering* made its debut in June, 1957. The new journal featured papers and articles of scientific and engineering interest to the profession.

(Continued on page 40)

Compatible Single-Sideband Transmitter Adapter, developed by Kahn Research Laboratories for Station WMGM, uses Hycon Filter Model 100 KUC.

Radio Tower of Broadcast Station WMGM (50,000 watts)

Accurate phase and frequency response for Single-Sideband Transmission . . .

another problem solved by HYCON FILTERS

The first domestic broadcast installation of the Compatible Single-Sideband Modulation Method has recently been completed by Broadcast Station WMGM of New York City on an experimental basis. Advantages of this system are improved fidelity, improved range in the presence of co-channel interference, resistance to fading and reduction in spectrum space. Because of their ability to meet the stringent requirements for the SSB frequency selective networks, Hycon Filters were chosen for this installation by Kahn Research Laboratories, designers of the CSSB Transmitter Adapter.

Whether your selectivity problems are in transmission or reception, AM or FM, mobile or fixed equipment, Hycon quartz crystal Filters offer you these advantages: LOW COST — standard models; LOW DISTORTION—passband uniformity within ±½ db; HIGH STABILITY — inherent in crystal resonators, also freedom from microphonic behavior; ZERO MAINTENANCE — hermetically sealed, requiring no realignment or readjustment. Hycon Eastern, Inc. can assist you in the selection of filter characteristics best suited to your needs. *Write for Crystal Filter Bulletin.*

ELECTRICAL SPECIFICATIONS (Model 100 KUC)
Carrier Frequency: 100 KC
Attenuation at carrier +300 cps: 2 db maximum
Attenuation at carrier +6000 cps: 2 db maximum
Attenuation at carrier −300 cps: 60 db minimum
Insertion Loss: 10 db maximum
Passband Response Variation: ± ⅛ db
Impedance: 8200 ohms
Dimensions: 5⅜" x 3" x 2⅜"

ALSO AVAILABLE: Model 100 KLC—Lower Sideband
Model 100 KPA—Carrier Selection

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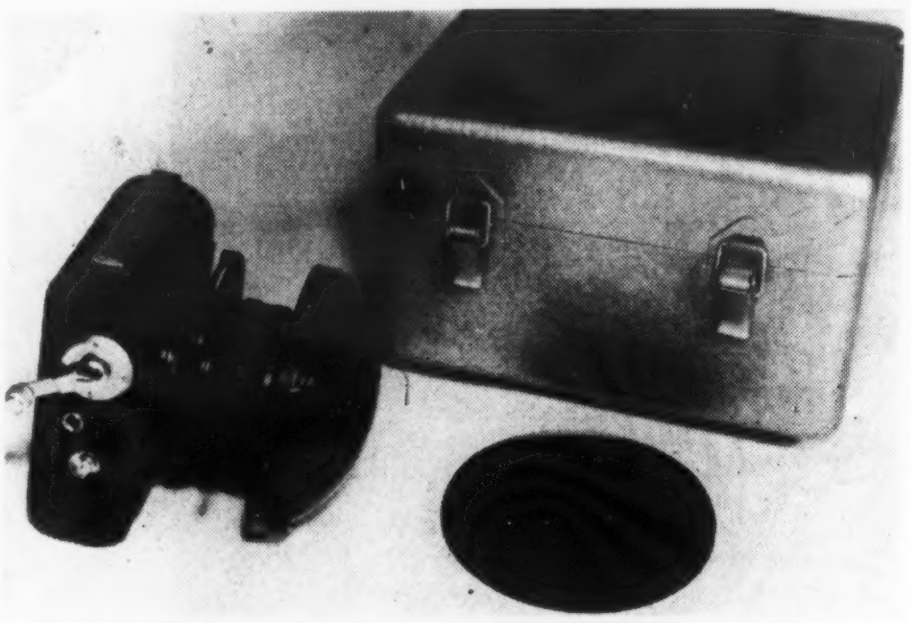
Work of the new society will be carried on principally through local chapters located in many principal cities of the United States such as Washington, D. C., New York City, Rochester, N. Y., Chicago, Ill., Los Angeles, Calif., Dayton, Ohio and others.

Monthly technical meetings are held in the various chapters and an annual technical conference, the first of which will be held Sept. 9 to 13, 1957 at the Berkeley-Carteret Hotel, Asbury Park, N. J.

Address of the Society of Photographic Scientists and Engineers is Box 1609, Main P. O., Washington, D. C.



This new Nikon "Fisheye" camera has 180-degree vertical and horizontal coverage. It uses standard 120 roll film and produces 12 circular pictures on a 2¼" x 2¼" square. The camera, representing an important stride in the field of ultra-wide-angle optics, is designed to view objects as a fisheye sees and is available only on special order.

New "Fisheye" Camera Takes 180-Degree Picture

A new camera that has 180-degree vertical and horizontal coverage has been developed by Nikon, Inc., 251 Fourth Ave., New York 10, N. Y.

Called the "Fisheye," the camera uses standard 120 roll film and produces 12 circular pictures on a 2¼" x 2¼" square. The camera is equipped with a Nikkor lens which represents an important optical advance in ultra-wide-angle optics. The lens has a focal length of 16.3mm and is designed to "see" as a fisheye sees.

Because of the wide coverage a viewfinder is not absolutely required since the photographer can see the approximate coverage from the reflection in the lens. The camera is provided with three aperture settings, f/8, f/11 and f/16 and shutter speeds ranging from ½ second to 1/200 second.

The camera can be handheld and is equipped with an automatic film counter and a single-stroke wind-back film advance crank.

Although the camera is designed primarily for scientific work, and particularly for sky and cloud conditions, it may be used for any purpose for which extreme wide angle coverage is desirable.

The price of the camera is $3,000 and it is available only on special order.

Viewing Negatives as Positives

Professional photographers, who are plagued with the time-consuming process of working proof prints in order to determine the best negative for printing, need worry no longer, for a unique European development which makes possible the viewing of negatives as positives, has been announced by the C. P. Goerz American Optical Co., Inwood, N. Y., the American distributor.

The instrument, which is called the Vertoscope makes it possible to view any film negative instantly as a positive, enlarged 2½ times.

The principle of operation of the Vertoscope is as follows: A fluorescent screen is excited by ultra-violet light radiations, causing it to glow. The glow effect is cancelled out by the exposure of the fluorescent screen to infra-red radiations.

As the image of the negative is projected onto the fluorescent screen, using the infra-red light source, the dark areas of the negative do not permit the transmission of the infra-red radiation. The clear areas of the negative readily pass the infra-red. Therefore, the fluorescence is cancelled in the regions that are of light density and the fluorescence of the screen is not cancelled in the areas corresponding to the dense areas of the film. These areas continue to glow and appear bright to the viewer. Thus the values of the negatives are reversed. The image viewed is the equivalent of a positive print with corresponding intermediate tones faithfully reversed.

The process is continuous as long as the fluorescent screen is excited by the ultra-violet radiation. Variations in contrast are easily produced by varying the intensity of the light source by means of a single knob control. This permits the reversal of thin or dense negatives.

All negatives up to 2¼" x 3¼" or 70mm format, in any length, may be viewed. A rotating negative carrier swings 180 degrees for vertical or horizontal subjects. A larger negative carrier up to 105mm is available. Two viewing parts permit simultaneous viewing by two observers.

The Vertoscope is equipped with a 1,000 watt lamp contained in a housing which is blower cooled. The instrument is designed for 110 volt A.C. operation and consumes 1250 watts. Overall dimensions of the Vertoscope are 13½" x 25" x 16½".

A New 360-Degree Azimuth Camera

A new 360-degree azimuth camera for recording horizon profiles, plane table work and similar uses has been developed by the Aero Service Corp., 210 East Courtland Street, Philadelphia 20, Pa.

The horizon camera uses 35mm motion picture film and its precision design assures very accurate measurement of azimuth angles despite differential shrinkage of the recording film or photo prints.

First used to record vertical and horizontal images for the radar station sites of the Distant Early Warning Line in Northern Canada, the camera weighs approximately 20 pounds and mounts on a surveyor's standard tripod.

The horizon camera is available with a choice of lens and choice of scales for the azimuth angle. Current models use a 12- or 20-inch lens and have horizon scales of approximately 5 degrees and 10 degrees per inch. A flare-reducing mask permits photographing almost directly into the sun with good results.

Set up and leveling for the horizon camera follows the same routines as setting up a surveyor's level. The camera turns through its 360 degree arc in approximately one minute, the speed of turning being pre-set to control the exposure time. The constant speed drive motor is operated by a 24-volt battery.

Film capacity is approximately 400 feet, sufficient to survey about 60 sites. The film chambers are darkroom loaded but may be installed or changed in daylight, so different films may be used as required to penetrate ground haze. Infrared and panchromatic film are the principal types used.

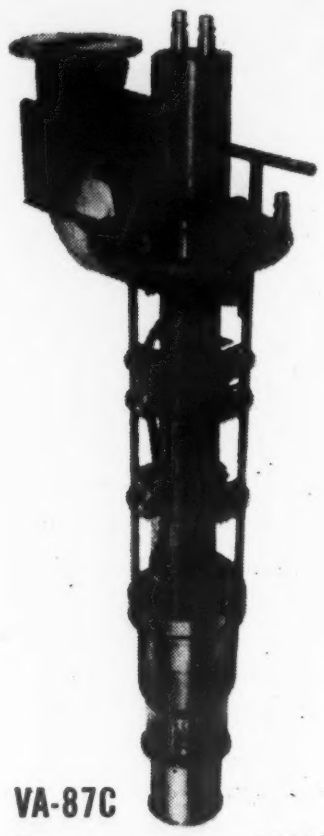
FILLING THE GAPS IN FREEDOM'S FENCE

The possibility of low-level bombers, slipping through the continental radar fence, has been the cause of much concern in our Air Defense Command. But a new "gap filler" radar eliminates the shadow areas caused by the earth's curvature and irregularities of terrain . . . helps give instant warning of the approach of intruding aircraft.

Vital in the chain of "gap filler" radar sites is a Varian Type VA-87 klystron amplifier, sending out a million-watt pulse of power a thousand times a second on a 24-hour-a-day basis. It provides the absolute dependability necessary to our national security. Result—a radar that will operate fully automatically, for prolonged periods of time, with neither operating nor maintenance personnel at the radar site.

Complete dependability is a characteristic of *all* Varian klystrons, along with extreme ruggedness, frequency stability, and outstandingly long life in service. Write the Varian application engineering department for complete specifications on the Type VA-87, or ask your Varian representative for a copy of the Varian Catalog.

Varian is now building more than 1,000 VA-87 klystron amplifiers for the United States Air Force, for use in the AN/FPS-18 gap filler radar systems being manufactured by Bendix Aviation Corp.



VA-87C

Frequency range: 2800-2900 Mc
Peak power output: One megawatt
Duty cycle: .003
Power gain: 60db

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The Trend of Facsimile in Military Communications

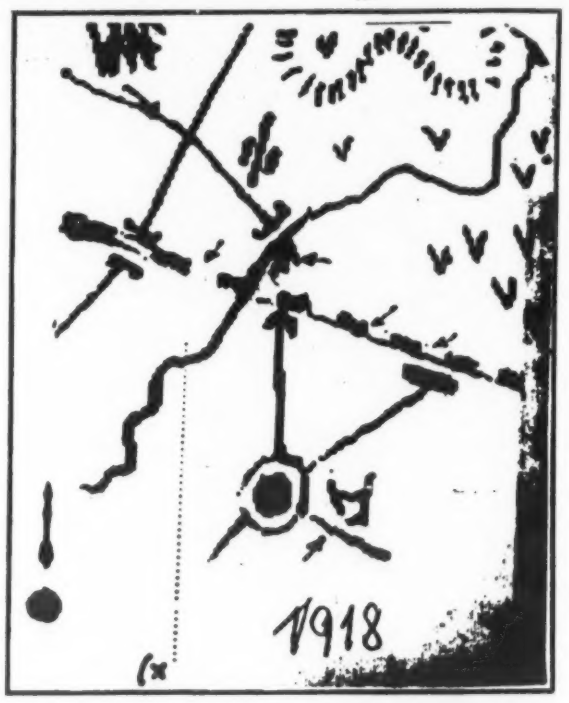
by A. G. Cooley, Executive Vice President, Times Facsimile Corp.

Editors Note: The following three articles are the first in a series of technical papers presented at the Eleventh AFCEA National Convention. Additional articles will be published in subsequent issues of SIGNAL.

SAMUEL MORSE HAD HARDLY finished learning the Morse Code before the inventors of his day were trying to find a graphic means of communication. Their goal was a system that would deliver a message as a facsimile of the original.

The first facsimile equipment was built and tested in 1848.

As other methods of communications improved through the years up to 1930, the apparent advantages of facsimile for message communications became less obvious, and the facsimile pioneers directed their attention more and more toward picture transmission. One exception was Dr. Arthur Korn's work in transmitting tactical maps for the Wermacht in 1918 and weather maps for Dr. Bjerknes of Norway around 1923.



Tactical map transmitted by Korn, Brest Litovsk (Russia) to Cologne.

Since 1926 the United States Navy and the Weather Bureau have been interested in facsimile. At that time they transmitted weather maps from the Navy Radio Station NAA to two warships with a system developed by C. Francis Jenkins.

General George Gibbs described in a 1930 edition of *Electronics* the transmission of facsimile messages from a Signal Corps plane flying over San Francisco.

Commercial photofacsimile, developed and operated by the Bell System, got under way in 1925. Message facsimile has been a regular part of Western Union's telegraph system since 1939. Now they have approximately thirty thousand installations.

Facsimile was ready for service during the tune-up for World War II. It was used in Spain during the revolution. Its next service was in Poland. Successful military tests were made by the United States Signal Corps at the Plattsburg, Ogdensburg and the Louisiana maneuvers prior to World War II. These tests led to the adoption of facsimile for military uses by the Allies.

One very important service performed during the Normandy invasion was the transmission of reconnaissance photographs. The photographs were taken by observation planes flying over Normandy. They returned to England where the pictures were developed, analyzed, and then transmitted by facsimile to the front line troops, all within an hour from the time when the pictures were taken.

From a central weather plotting station in England, weather maps were transmitted to many of the airfields so that all missions would be using the same weather interpretations, thus coordinating their navigation calculations. This aided in bringing the planes together at their scheduled rendezvous. The weather map transmission system proved extremely serviceable during tactical operations.

After V-E day the traffic load fell off and the operators entertained themselves with the transmission of interesting French photographs. It was decided that better use could be made of the equipment, so it was returned to the States where the Air Weather Service set up a national wireline facsimile weather network.

Around the clock, seven days a week over 600 military, Weather Bureau and commercial meteorological offices now receive facsimile charts from Suitland, Maryland, where they are prepared by Weather Bureau meteorologists.

Radio transmissions supply weather information to ship and shore stations for the entire North Pacific and North Atlantic areas. Navy ships receive special bulletins by facsimile and transmit various types of material including drawings required in making emergency ship repairs.

The Air Force is using facsimile over land lines for administrative communications and is setting up a second weather network to cover additional requirements.

The Signal Corps operates a radio facsimile service with headquarters in the Pentagon. There are circuits to Japan, Honolulu, Europe and Africa. Of special value is the circuit to Eritrea on the Red Sea where the mail service is particularly poor. The traffic consists of engineering drawings, photographs, bills of lading, etc.

The Weather Bureau uses facsimile equipment of the newsphoto type to transmit photographs of radarscope presentations showing hurricane cloud formations. An improved type of equipment of the flat bed scanner type has recently been delivered to the Air Force for use in a similar service.

Fax Systems In Pioneering Phase

The need for a facsimile field unit equivalent to the walkie-talkie has long been recognized. Two or three attempts have been made to develop suitable equipment but military requirements have not as yet been met. A new project of development will soon be underway for the Marine Corps.

The transmission of reconnaissance photographs from plane to ground is a project that has received off and on attention since the Signal Corps' transmissions in 1930. Reconnaissance photographs contain small detail which require very fine scanning, approximately 500 lines per inch definition. Transmission over a voice frequency channel of a 7 by 9 inch aerial photograph would require more than an hour and a half. To make the transmission in five minutes a band width of 30,000 cycles is needed. The problem of providing such radio channels from plane to ground base station and channels for repeating from the base station to headquarters limits the scope of this application of facsimile.

Hospital services will soon benefit by facsimile. A system has been developed at the suggestion and under the guidance of Commander J. Gershon-Cohen, Medical Corps, U. S. Naval Reserve, as a result of his military experience during World War II.

(Continued on page 44)

Many test transmissions have been made to Bethesda Naval Hospital, Wright-Patterson Air Force Base and Rome Air Force Base from several field stations at distances of 60 to 600 miles. The results show that by means of facsimile the small dispensary unit can enjoy the same expert interpretation of the X-ray films as the largest and best staffed hospitals. Plans are now underway for operational tests on a more extensive scale.

The Strategic Air Command is experimenting with a communications system using various commercial types of equipment so as to become acquainted with facsimile operations with a minimum of delay.

When new and improved equipment designed especially for message communications becomes generally available to the military, the facsimile traffic load will unquestionably increase, partly because facsimile is considered to be error-free in operation. While there may be some exceptions under certain conditions, facsimile does have a very substantial advantage over other methods in this respect.

Facsimile is also desirable in military work because only a few minutes are required for operator training. Some of the recently designed equipment requires only the dropping of a message in a slot and pushing a button.

Communicators do not even want to be bothered with pushbutton warfare, nor do they want to be handicapped with the element of time in transmitting their communications. The need for operating manpower and maintenance is looked upon with fear and disdain.

To meet this challenge of the communicators, the facsimile manufacturers and the operators of the communication channels are working overtime. Today's equipment is good. We want you to make the maximum use of it so we will learn the needs of tomorrow's machines.

Speed Of Transmission

Let us now consider the problem of speed. We all think of television as an instantaneous operation—so why can't we have a facsimile system which is also instantaneous. One such system was developed at considerable expense to a commercial company. Its capacity was demonstrated by transmitting the one thousand page novel, "Gone with the Wind" in the amazing time of two minutes and twenty-one seconds. The equipment could transmit a half million words per minute over a standard video circuit.

Last year *The New York Times* wanted to deliver to the delegates of the Republican Convention in San Francisco, papers containing the news in the final edition which is closed in the composing room at 2:45 am. Eastern Standard Time. Without the use of jet planes, deliveries of papers printed in New York could not be made to the hotels in San Francisco by 7 am Pacific Time. So, a special set of facsimile equipment was built to transmit at the rate of one newspaper page in two minutes.

Received copy was on film from which engravings, matrices and stereotype plates were made for printing on a rotary press. The success of this operation has encouraged many military communicators to look toward high speed facsimile for future requirements.

The facsimile equipment can be designed to operate at most any speed but each type of communications channel has definite limitations. Over a good voice frequency channel normally used in telephone conversations, one can transmit 2500 pulses or elemental areas per second. This corresponds to 15 square inches per minute when scanning at the rate of 100 lines per inch. Such a rate is fine enough for average copy. In transmitting *The Times* to San Francisco, a scanning rate of 200 per inch was used in order to reproduce the small print in the financial columns.

This is an important point to remember in facsimile. A system designed to transmit small type will be spinning its wheels when scanning large type. And, it will draw a blank when scanning blank areas.

The first approach toward the transmission of the maximum amount of information in a given time is, therefore, optimum use of the message blank. The next is the transmission of more elemental areas per second. The fastest circuits commercially available are television channels. They are capable of transmitting nearly eight million elemental areas per second as against 2500 over a voice frequency channel. In other words, the TV channel can transmit approximately 3000 times the information of a voice channel. The channel cost is approximately twenty-five times as great. If we are permitted to dream, we might say that in speeding up by a factor of 3000 there is a cost savings of over 100 to 1.

This is blue sky thinking of course, but there are a lot of blue sky planners around Washington and they might as well have this idea to work on.

At the present time no one is known to have enough traffic to load up a TV circuit and there are relatively few points where TV terminals are available. There is, however, encouragement for the communications planner who wants a serviceable high speed facsimile system in the reasonably near future.

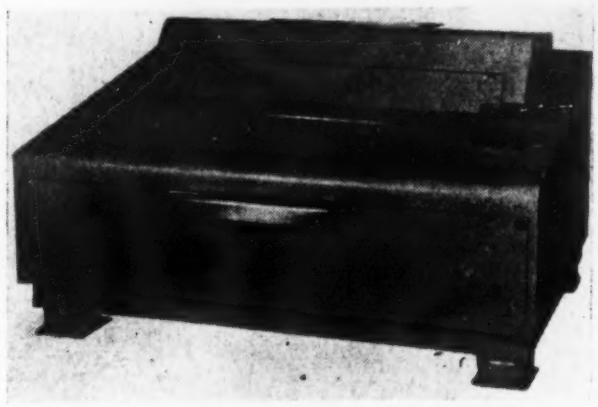
In many carrier telephone systems a 48kc band is divided up to provide twelve telephone channels. The 48kc circuit is referred to as a group circuit. Facsimile tests have been made within the past few weeks over these circuits and they were found to have a capacity of 200 square inches per minute with 100 line scanning definition. This is equivalent to 2500 words per minute of elite typewriter type.

Group circuit connections can be provided to most any point requiring service. If the group circuits are used to any great extent for facsimile, one of the distortion factors can be eliminated with additional equipment and the capacity increased approximately 100 per cent.

As facsimile develops in importance, more and more attention will be paid to the design of wireline communications facilities for the proper transmission of facsimile signals. Fortunately, the special considerations that facsimile requires are also needed for the transmission of data processing signals so there is good justification for the cost of improving the circuits.

Equipment

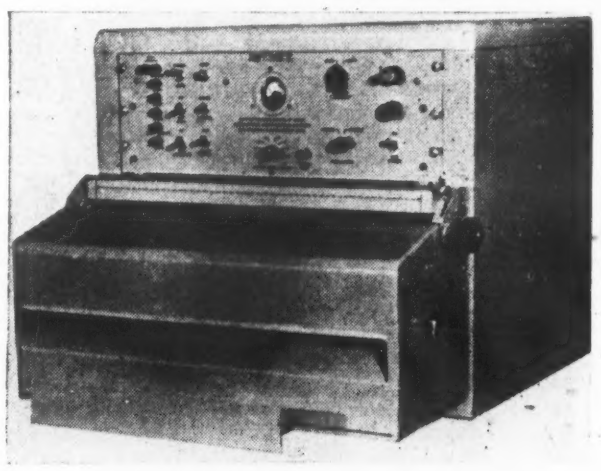
Facsimile equipment designed and built during World War II requires a certain amount of manual operation. In the interests of operating convenience a continuous type of recorder has been developed for meteorological services. First deliveries of this recorder in its military form, AN/UXH-2, will be made within the next year. The commercial version is now in production after nearly fifteen years of engineering and development work.



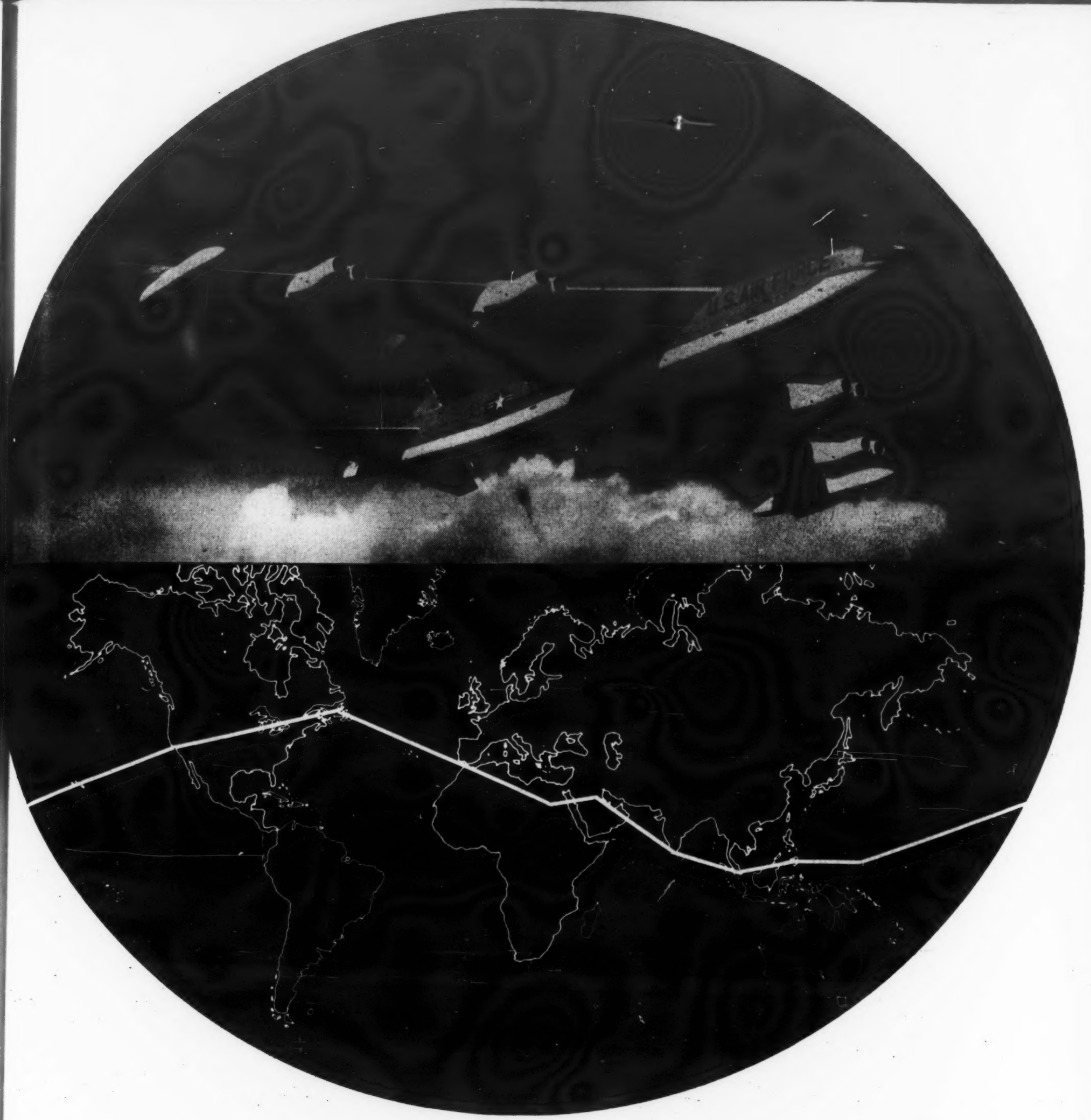
Continuous type weather map recorder AN/UXH-2.

The UXH recorder feeds out a continuous web or strip eighteen inches wide and at the rate of twelve, eighteen or twenty-four square inches per minute. It is designed to operate over voice frequency circuits. At the lower speed the circuit requirements are lenient; at the higher speed the circuits must meet the highest standards in the 600 to 2600 cycle range.

A continuous type of transmitter to cooperate with this recorder has just been delivered to the Bureau of Ships. It is designated as the T-643/UX.



Continuous type transmitter T-643/UX.



THE FLIGHT HEARD 'ROUND THE WORLD

Recently three B-52 bombers flew around the world in 45 hours and 19 minutes. They were only specks in the vastness of the sky, yet they were in voice-contact every mile of the way—with SAC headquarters in Omaha, with each other, with bases along the route and with the KC-97 tankers that refueled them in the air.

Their speed-of-light contact was the AN/ARC-21 liaison communications set in each of the ships. This is a long-range, pressurized, high-altitude airborne system, capable of world-wide communications. It may be operated by the pilot, so no radio operator is needed. It is characterized by minimum training requirements, simplified maintenance, high reliability, positive channel selection —with a choice of any 20 of 44,000 frequencies.

In this as in other ways, RCA serves our Nation's armed forces. RCA scientists and engineers are constantly creating, designing and producing new and better electronic systems and equipment.

RCA Tmk(s) ®

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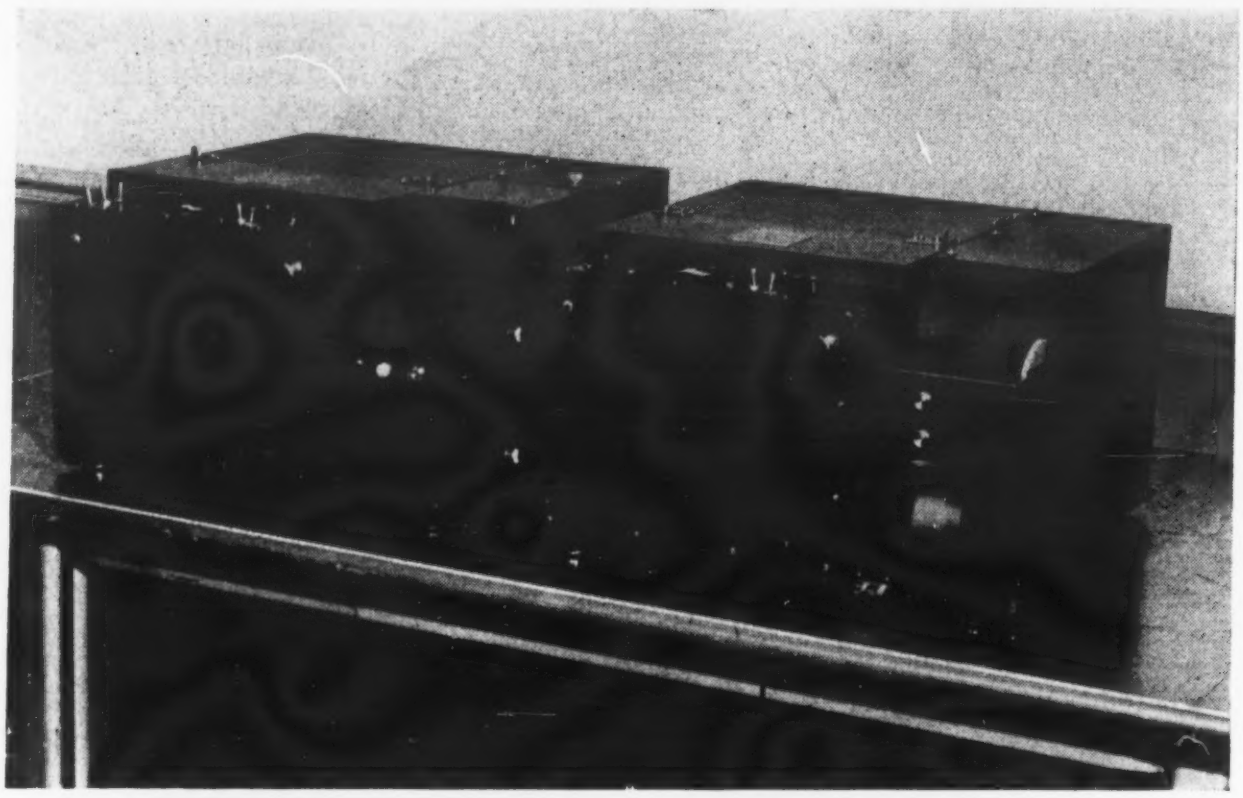


Flat bed type set AN/GXC-4 for operation with polaroid film.

New equipment, AN/GXC-4, built for the Air Force to transmit radarscope pictures in the flat scanner type, will transmit from a polaroid picture and record on a polaroid film with a scanning definition of 200-lines per inch. Although the basic design is very old, the U. S. Army Signal Engineering Laboratories built the first experimental machine that worked successfully in scanning wide copy.

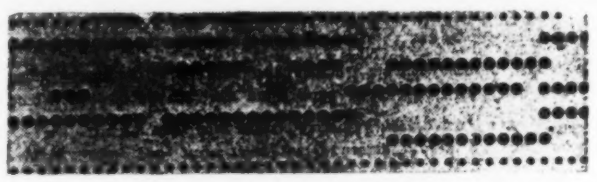
Computer Techniques

Computer techniques were used in the transmission of radio photos by one of Korn's systems across the Atlantic in 1922, and cable photos by the Bartlane system in the period around 1925. The 5 pulse digital code was employed. Before abandoning the cable photo system, plans were developed to speed it up by making fast jumps along scanning lines of uniform density.

Considerable excitement has again been aroused over the possibilities of computer techniques. The leaders in information theory are confident that a method can be devised to reduce the channel band width by a factor of 100.

It is believed that plans for doing this are close to completion. But, there are certain drawbacks to this approach. Any savings in wireline costs may be offset by equipment complexity.

One of the basic information theories is that error-free transmission is possible up to the channel capacity, provided that the proper coding is used. As the noise increases, the channel



Portion of coded facsimile picture, Korn, 1920.

capacity decreases. By varying the size of the transmitted characters, facsimile can adjust itself to the channel capacity as noise changes.

The facsimile system is in itself a simple analog computer. The read-out delivered when transmission is made under bad conditions may look like pretty sorry copy, but at this point it is passed on to a second computer which for this type of work is far superior to the IBM 706, Univac, Bizmac and the Maniac combined. This superior computer, which is so effective when interpreting communications presented in the form of facsimile recordings, is the human eye and brain.

I am going to illustrate to you a picture of a facsimile recording made under simulated noisy radio receiving conditions. Noise full of spikes was superimposed upon the facsimile signal. From the loudspeakers you will hear the signal as it appeared at the input terminals of the facsimile recorder. No filtering was involved. See photos at lower left corner.

Questions And Answers

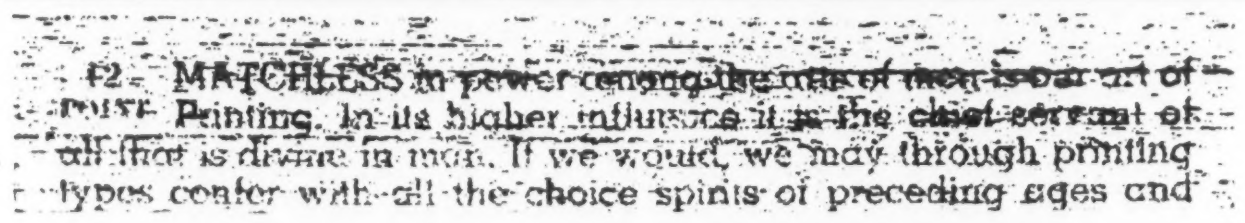
I know that many of you have questions outside the limited scope of this paper.

We often hear the question: Why is it that facsimile has progressed so slowly while other arts such as television have moved so rapidly?

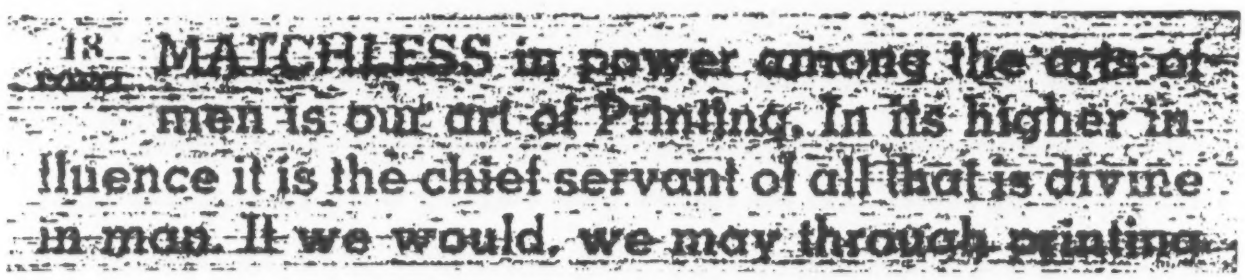
The development of facsimile has moved cautiously, partly because of the fear that an improvement in recording papers will require entirely new mechanisms. Another problem is that of the "chicken and egg" type. Before a low cost mass production design can be developed, many years of operating experience are required. Few are willing to invest in facsimile until such designs are ready.

What is the military doing to support the development of facsimile?

Probably five million dollars has been spent by the military in the development of facsimile since 1945. However, progress has been slow because of the time required in preparing specifications, procurement of funds and the letting of contracts. In line with the statements made by Admiral Bennett yesterday, I would like to say that fast progress can be made when military funds are available for the procurement and development of equipment based on best commercial practices. An example of how such a system did operate is found in a Bureau of Ships contract where the contractor was required to furnish equipment built in accordance with good commercial design and performance equal to or better than certain JAN approved equipment. In a very short time the equipment was developed at no expense to the Bureau of Ships except for a nominal rental cost. The contractor maintained the equipment and was, therefore, cognizant of design deficiencies even before the customer knew it and was able to make corrections on a day to day basis without going through the long harangue of obtaining approval for changes through channels.



Recording made through heavy noise—rate: 135 words per minute.



Same conditions as above, but at 75 w.p.m.

10 POINT MATCHLESS in power among the arts of men is our art of Printing. In its higher influence it is the chief servant of all that is divine in man. If we would, we may through printing types confer with all the choice spirits of preceding ages and learn all the knowledge acquired by men from the

Recording at 135 w.p.m. with no noise present.

Single Sideband Receivers

by H. F. Comfort, Radio Corporation of America

THE GROWTH OF RADIO COMMUNICATION by use of single-sideband techniques may be said to have been "slow but sure" over the past twenty-five years. As early as 1922, R. V. L. Hartley discussed the "Relations of Carrier and Sidebands in Radio Transmission." But the separation of the sidebands from the carrier wave and from each other and their separate use for radio communication seems not to have been seriously undertaken until a decade or so later. In 1933, A. H. Reaves reported on "The Single-Sideband System applied to Short Wave Telephone Links." Two years later in the Proceedings of the Institute of Radio Engineers, Polkinghorn and Schlaack described "A Single-Sideband Short Wave System for Transatlantic Telephony." The study of single-sideband techniques became quite widespread in the ensuing years.

Widespread adoption of single-sideband communication systems was retarded for some years by the size and complexity of the equipment and the requirement of extreme frequency stability. However, at present, techniques are available for securing adequate frequency stability. At the same time electromechanical filters, new phasing systems, transistors, and modular assemblies are reducing the size and complexity of the circuits and equipment. Currently, then, the retarding factors have been largely removed.

Single-sideband communication systems began to be adopted first because of the need for radio spectrum conservation resulting from the rapid growth of radio communications for both commercial, military, and amateur use. It was recognized that the bandwidth of radio frequencies required for communication by a single-sideband system was only half as great as for the conventional double sideband transmissions. In the second place, studies of the fading of amplitude modulated radio signals over long distances were beginning to reveal that the fading was frequency selective. The carrier was found to fade intermittently with respect to one or the other of the sidebands and the sidebands to fade with respect to each other. On radiated radio waves modulated to 100% by audio frequency signals, the selective fading of the carrier with respect to the sidebands produced over-modulation. The result—which was perhaps noted before the cause was fully understood—was that large distortion was noted in the audio signals recovered from the transmitted wave by demodulation at the receiver.

Distortion of the phase relationships of carrier and sidebands due to multipath transmission is fully as serious and perhaps more so than the direct relative amplitude changes above mentioned. Both of these troubles are avoided by use of single-sideband communication except for a possible slight amount of selective fading within the one sideband itself.

The advantages of single-sideband communication in narrower bandwidth and relative freedom from selective fading still exist today, of course. Others are now also recognized. A third advantage is that an interfering signal near the desired frequency is less troublesome than with conventional AM transmission since, with a suppressed carrier SSB transmission, no carrier is present at the receiver to heterodyne with the interfering signal. A fourth advantage is the decrease in power needed from primary sources at the transmitter for a given radiated power, as compared with a conventional AM transmitter. This power gain has been indicated by various writers to be in the order of 12 to 15 db, depending upon the transmission conditions.

The purpose of this paper is to describe a high frequency communications receiver which has been designed primarily for single-sideband reception. In order to make the receiver compatible with current communication systems, the necessary circuitry has been included to permit the detection of DSB amplitude modulated signals.

Such a receiver must have a system of frequency generation, stabilization, and control, of such accuracy that it is unnecessary to transmit any carrier at all for demodulation or synchronization purposes.

Frequency Standard

The concept involved is to use separate master frequency standards at both transmitting and receiving stations of such accuracy that frequencies equal to those at the transmitter, within the required tolerance for distortionless demodulation, can be generated locally at the receiver without the necessity of synchronizing signals from the transmitter. The frequency standard at each of the transmitting and receiving stations is a 1 megacycle highly stabilized crystal oscillator kept in an oven of accurately controlled temperature. Each is accompanied by the necessary number of frequency dividers, multipliers, and pulse shapers to produce both the required standard r.f. and pulsed output signals. The latter are the precisely spaced pulses of 100 kc and 0.5 kc repetition rates used to control or "lock" the frequencies of the oscillators of the Pulse Locked Generator. The former are the 3 mc and 350 kc standard injection frequencies for the second and third receiver mixers, respectively, and the 250 kc local carrier which is fed to the single-sideband demodulators.

A block diagram of the Frequency Standard developed by RCA is shown in Figure 1.

The basic unit of this frequency standard is the one megacycle crystal controlled oscillator which uses a Colpitts type circuit. Its quartz crystal is supported on a shock and vibration-free mounting within an evacuated glass envelope equipped with standard octal base connecting pins. Firmly clamped in its socket and mounted in an oven of accurately controlled temperature, this crystal controls the frequency of the oscillating circuit, the pulse locked generator, and the whole receiving system to well within one part in ten million under all conditions of shock and vibration.

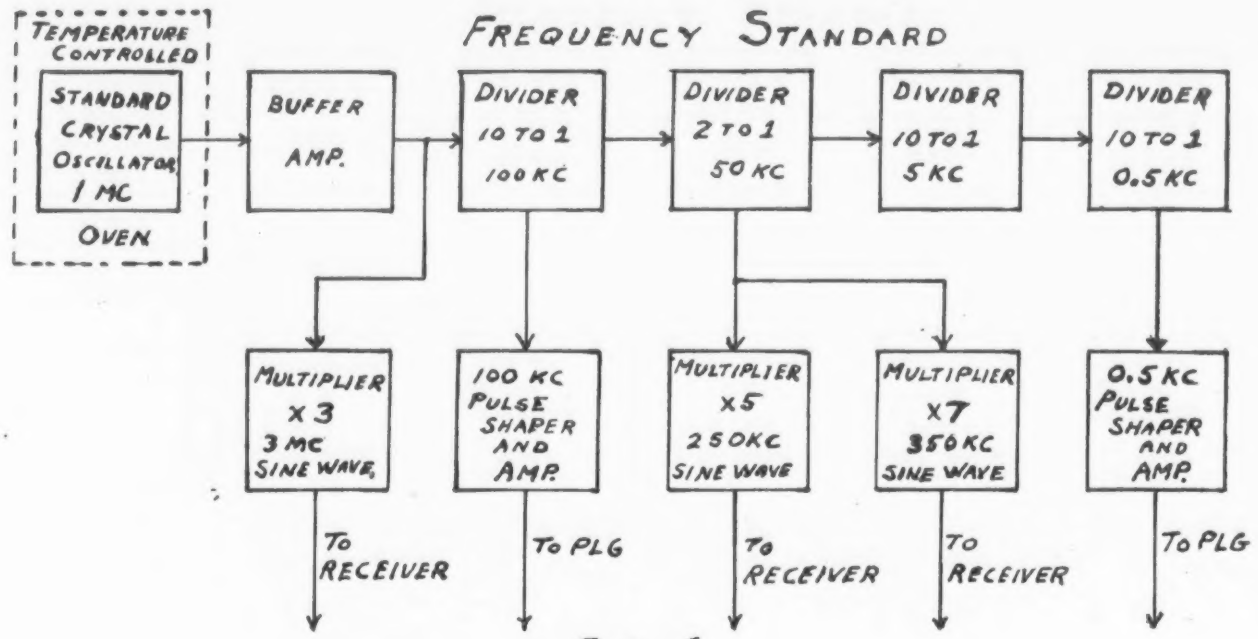


FIG. 1

The one megacycle output voltage of the temperature controlled, crystal oscillator type frequency standard is passed through a buffer amplifier to both a multiplying circuit and a dividing circuit. In the former, multiplication by 3 gives a standard referenced 3 megacycle voltage which is fed to one of the mixers in the receiver to be described herein. In the latter the standard frequency is accurately divided by 10, resulting in a 100 kc standard referenced frequency. This, in turn, is fed to a 100 kc pulse shaper and amplifier. Sharp pulses from the latter are fed to a pulse locked generator used with the receiver.

The output of the first 10 to 1 divider circuit is also fed to a 2 to 1 divider circuit and thence both to a 7 to 1 multiplier circuit and a 5 to 1 multiplier which, respectively, yield sinusoidal voltages of 350 kc and 250 kc. These are fed to the receiver for conversion and demodulation purposes respectively. In a separate circuit the 2 to 1 divider output experiences a further division by 100 in two divider circuits of 10 to 1 ratio each. The resulting 500 cycle signal, still accurately referenced to the 1 mc frequency standard is passed through a pulse shaping circuit and thence to the previously mentioned pulse locked frequency generator. It is now a train of pulses with a repetition rate of exactly 500 pulses per second.

Pulse Locked Generator

A pulse locked generator, as the name implies, is a generator of frequencies which are phase locked, or held accurately to their required values by comparison with the time spacing of pulses derived from and controlled by a frequency standard.

The pulses with 100 kc and 500 cycle repetition rates mentioned earlier are those used for phase and frequency locking of the pulse locked generator now to be described.

Figure 2 illustrates the pulse locked generator or PLG by means of a block diagram.

The RCA pulse locked generator contains three oscillators. Two of these are locked, or phase and frequency stabilized, by phase comparison of their output signals respectively with the 100 kc and 500 cycle pulses obtained directly from the Frequency Standard already described. Each of these is a conventional L-C oscillator. The frequency of the former varies from 2.9 to 27.8 megacycles whereas the range of the latter is only from 300 to 200 kilocycles.

The output of each oscillator is fed to a phase detector. The 100 kc pulses and the 500 cycle pulses from the frequency standard also are fed to the respective phase detectors. Now, if the phase of either oscillator output is different at the time of arrival of a later pulse than it was when an earlier pulse arrived, the associated phase detector develops an output error voltage which is of such polarity that, when applied to a reactance tube or voltage-sensitive capacitive diode attached to the oscillatory circuit, transient changes in frequency and phase of the oscillator voltage are initiated which restore them to their proper values.

The function of the third or master oscillator of the pulse-locked generator is to produce a voltage of such frequency that, when mixed with the desired incoming signal in the upper three frequency bands of the receiver, a 2400 kilocycle intermediate frequency mixer output signal results. For the 2 lower bands an intermediate frequency of 600 kc is to be produced.

For the reception of radio signals anywhere within the high frequency communication band of from 2 to 30 megacycles, the master oscillator is to be frequency controlled by the pulse locked oscillators over a range different from the above by the appropriate intermediate frequencies. The controlled range in the pertinent equipment is from 2.6 to 27.6 mc in 500 cycle steps. The master oscillator output is fed to a mixer for mixing with that of the 2.9 to 27.8 mc oscillator locked exactly to the multiple of 100 kc nearest that of the chosen frequency by the 100 kc pulses. The mixer output is compared in a phase detector with the output of the 300 to 200 kc pulse locked oscillator. Should the output of the master oscillator be not exactly on the required frequency to correctly receive the desired signal, an error output voltage will be developed in the pertinent phase detector. This voltage applied to a reactance tube or voltage sensitive capacitive diode causes the frequency error of the master oscillator to be eliminated. In each of the three frequency control loops of the pulse locked generator, the dc error voltage is passed through a low pass filter to eliminate any spurious signal or hum voltages from modulating it and possibly causing hunting, etc., of the controlled oscillator frequency.

This frequency control system has been tested under all standard prescribed conditions of shock and vibration. In no case have the frequency deviations of the system exceeded the prescribed goal of one part in ten million, or 3 cycles at 30 megacycles.

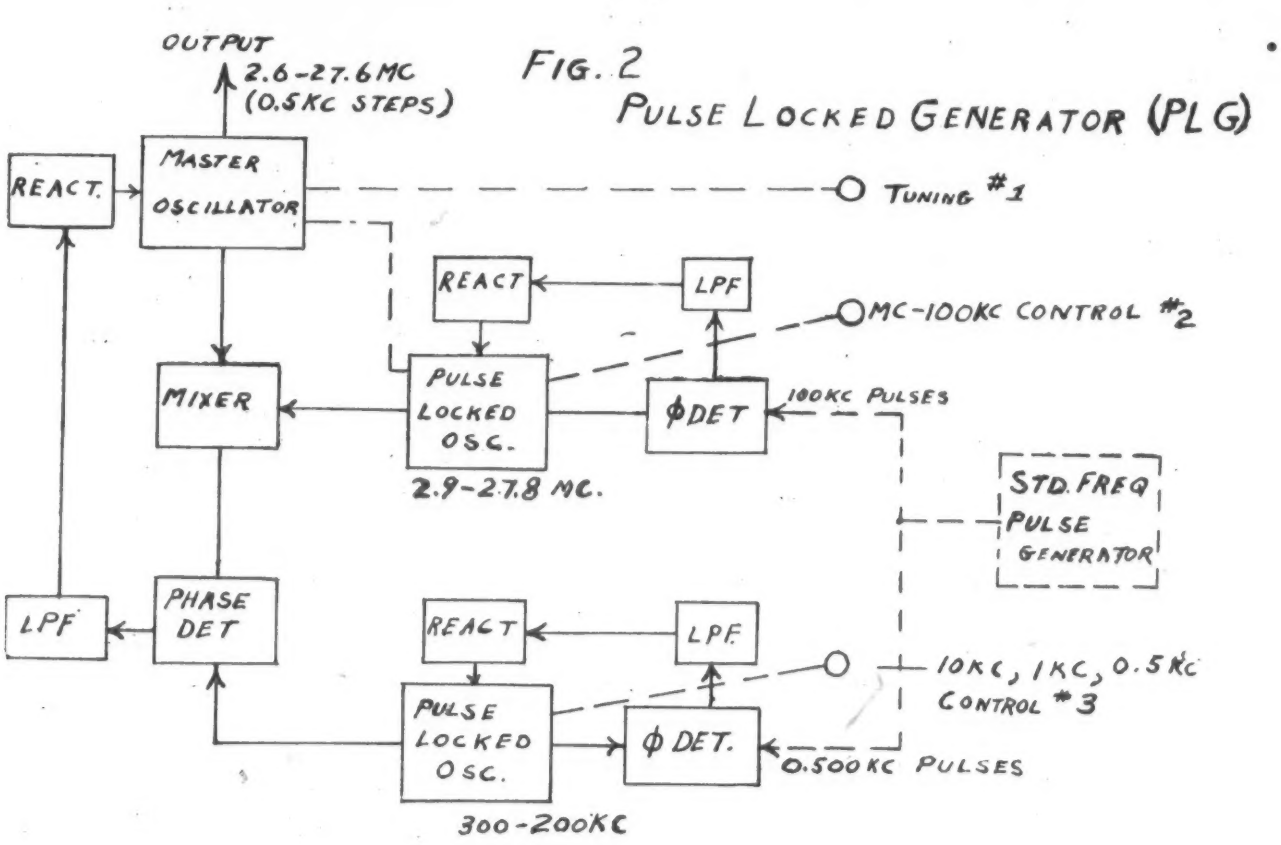


FIG. 2
PULSE LOCKED GENERATOR (PLG)

Figure 2

Here, in Admiral's Nucleonics Laboratory, radiation tests are conducted with a cobalt 60 source rated at 20,000 curies. The observer is shielded by 41 inch walls of magnetite ore within steel shells, and a 42 inch lead glass window.

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Figure 3

Figure No. 3 is a photograph of the Pulse Locked Generator.

The set-up procedure is very simple. The desired frequency is set up on the dials, and this gives us the selected frequency. But, in order to obtain the maximum assurance that the frequency will remain correct under the various environmental conditions, a tuning meter is provided to permit setting of the oscillators to the center of their pull-in range.

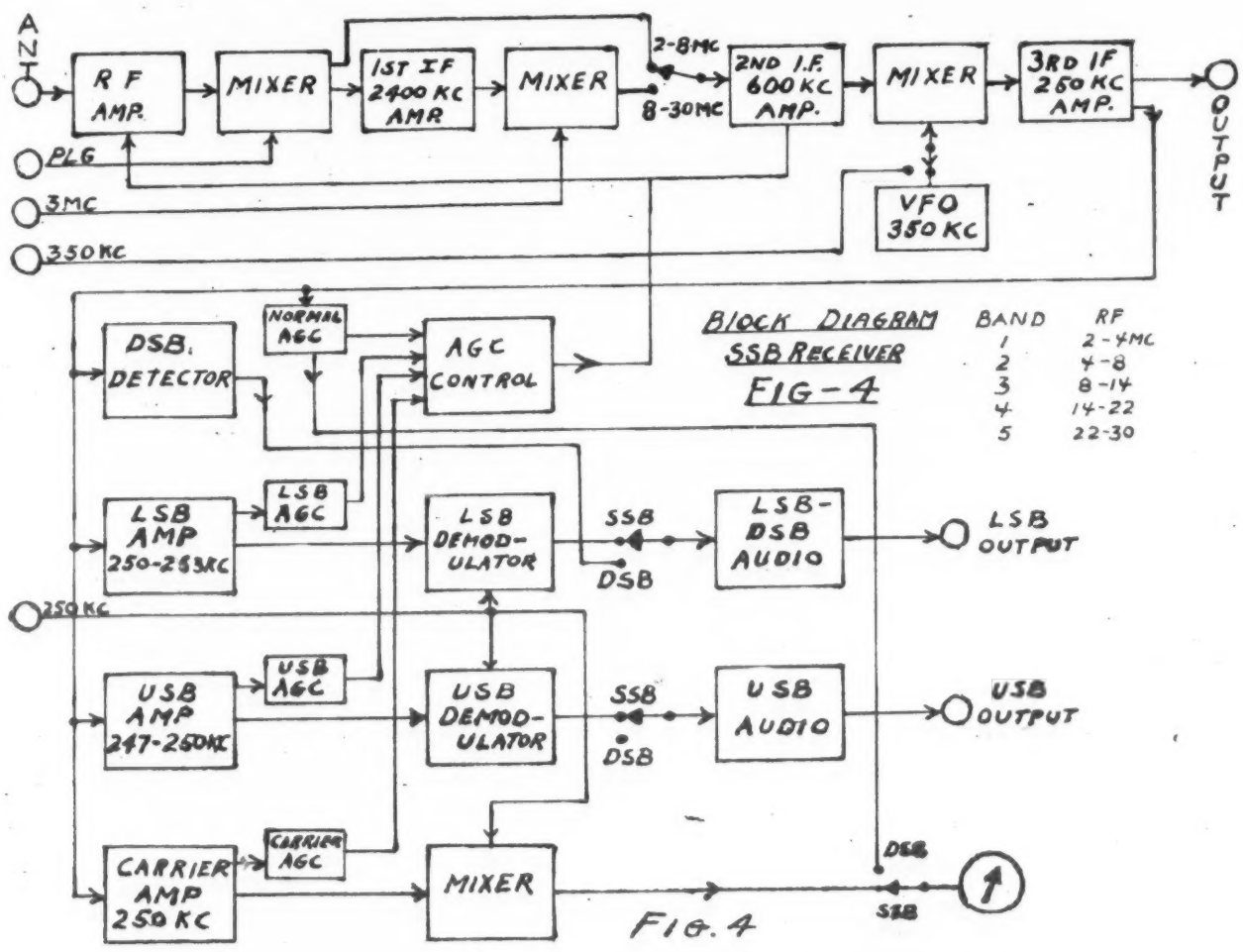
Any subsequent tendency of any of the oscillators to drift from frequency and phase equality with the chosen multiples of the 100 kc and 500 cycle pulses from the frequency standard will be prevented by the action of the pertinent phase detector and reactance tube.

Single-Sideband Receiver

Several factors were involved in reaching a decision on the type of receiver to design and the types of communication service it would provide.

It was believed that for possible use by the Armed Services such a receiver should be capable of single-sideband or twin-sideband operation with either partially or fully suppressed carrier, as well as possible use for double sideband operation or continuous wave telegraph. The receiver must have low distortion in multiple tone operation, good sensitivity, and freedom from crosstalk when operating in the vicinity of powerful transmitters. For some tactical uses an SSB receiver for military communications would need only to operate on one sideband with completely suppressed carrier and would be used primarily for speech communication. However, it was decided to design this receiver to cover the greater variety of services above mentioned.

A block diagram of the receiver is shown in Figure 4. The receiver is capable of receiving single-sideband transmissions with or without carrier suppression, twin channel single-sideband transmissions, conventional amplitude modulated signals, frequency-shift-keyed signals, tone modulated continuous wave, or continuous wave signals.



The radio frequency amplifier has two tuned circuits ahead of the first tube followed by two tuned stages using pentode tubes. As is shown in the upper left corner of the block diagram the amplified r-f signal proceeds from the r-f amplifier to the first mixer stage. Here the correct frequency is injected from the pulse locked generator. The dials of the pulse locked generator are so calibrated, however, that they read the exact value of the frequency of the desired incoming signal instead of the difference between it and the intermediate frequency to be produced in the mixer. In the r-f section of the receiver, any one of five sets of r-f coils may be chosen by the bandswitch on the panel thus dividing into five bands the h.f. range of 2 to 30 megacycles.

An incoming signal in the range of the first and second bands has its frequency changed in the first mixer to a 600 kc intermediate frequency and passes directly to the 600 kc or 2nd IF amplifier. Signals in the range of the remaining three bands emerge from the first mixer at 2400 kc, pass through the 2400 kc or 1st IF amplifier and thence to a second mixer into which an exact 3 megacycle signal from the frequency standard is also injected. The result of mixing these 2 signals is a 600 kc intermediate frequency. After amplification in the 2nd IF amplifier, the signal proceeds to the 3rd mixer in which both the signal and an exact 350 kc voltage from the standard frequency generator are mixed. In case of receiving an incoming r-f signal whose frequency is not an exact multiple of 500 cycles, the VFO switch is thrown to ON. This allows injection of an oscillatory voltage centered at 350 kc at slightly reduced accuracy, but adjustable to any frequency within about 250 cycles of 350 kc, and on either side of it.

The 250 kc output of the 3rd mixer is amplified in an amplifier whose bandwidth is 6 kc. A 70 ohm output from this amplifier is available at the rear of the receiver for special uses in which a 6 kc bandwidth is required. The signal at 250 kc is also fed to four circuit branches. The first of these is an ordinary diode circuit which accomplishes detection in case the received signal is one using double sideband amplitude modulation. The other three branches are, respectively, amplifiers and following equipment for lower sideband, upper sideband, and carrier signals. The upper and lower sideband branches each consist of their respective sideband amplifiers and filters, demodulators, and audio amplifiers. Both of these branches terminate at their respective phone jacks, both on the front panel for headphone connection and at the rear of the receiver for connection to the proper terminal equipment.

Single or double sideband reception may be selected by the front panel function switch. With the function switch in the SSB position, either side-

band can be used for voice; or voice can be used, for example, in the upper sideband channel while multiple tone operation with as many as sixteen frequency-shift-keyed (FSK) channels is occurring in the lower sideband channel. Continuous wave signals can also be processed in the lower sideband branch. When the latter type of operation is chosen by the CW switch on the panel, a narrow band-pass filter centered at 1000 cycles is automatically switched into the lower sideband audio amplifier in place of the low pass filter normally in use there for the recovery of speech signals.

The carrier amplifier is used primarily to supply a carrier source of voltage for automatic gain control when a partially suppressed carrier is transmitted. Various degrees of carrier suppression can be compensated for by use of the front panel carrier control which is used to adjust the gain of the carrier amplifier. A very sharp filter of about 200 cycle bandwidth contained in the latter amplifier removes all sidebands from the carrier as well as practically all noise components. The amplifier output is thus a noise and modulation free carrier for use as a source of AGC voltage when needed.

The completed radio communications receiver, for the control of which the frequency standard and pulse-locked generator were designed, is illustrated in the photograph of Figure 5. The front panel layout is as follows: The two function switches are shown in upper central part of the panel allowing reception of either single-sideband, double-sideband or continuous wave signals. The bandswitch is to be seen at the center left and the r.f. tuning control and frequency dial on the upper left portion of the panel. At the lower left is the r.f. gain or volume control. Next toward the center, near the bottom of the panel, is the adjustment for the automatic gain control threshold. The toggle switch below the latter selects a fast or slow AGC time constant as desired. The carrier level control is at a lower central position. This is used, only when carrier operated AGC is desired, to raise the level of carrier until it is the strongest of several input voltages to the master AGC control and therefore governs the operation of the latter.

Two headphone jacks for the reception either of upper sideband transmissions or for either lower sideband or conventional AM are at the bottom of the panel to the right of center. Above them are access holes for screw-driver adjustment of gain of either of the two audio amplifiers of the receiver. At the extreme right of the panel are the VFO On-Off switch, tuning control, and frequency dial, mounted in that order from bottom to top of the panel. The tuning meter to the left of the VFO tuning knob indicates when a given radio transmission is correctly tuned by the VFO.

Receiver Characteristics

Measurements made on the receiver have indicated its characteristics as follows:

1. *Sensitivity:* The conventional AM sensitivity with 70 ohm antenna input and a 1000 cycle tone for modulating a 2 megacycle transmitted carrier was 1.5 microvolts input for a 10 db signal to noise output. Over the 2 to 30 mc frequency range the SSB sensitivity was from 0.3 to 1.0 microvolts for a 10 db signal-to-noise ratio using a 1000 cycle tone for modulation but with no carrier transmitted.

2. *Selectivity:* The upper sideband selectivity is due to the upper sideband filter, whose pass band extends roughly from 247 to 249.6 kc.

The lower sideband filter, likewise, extends roughly from 250.4 to 253 kc. Both filters are of the electromechanical type.

Measured between frequencies where the signal response is down 6 db from the maximum of the pass band, the bandwidth of these sideband filters is 3.2 kc.

The adjacent channel selectivity of the sideband filters is such that tones between 400 cycles and 3000 cycles are attenuated at least 55 db in the other channel.

3. *Distortion:* Requirements for distortion limits in the receiver are approximately 1% for teletype and 5% for voice. Two tone intermodulation distortion measurements were made using tone inputs of 1000 and 1400 cycles to the sideband amplifiers. All distortion products were found to be less than 1%, indicating greater than 40 db attenuation below signal level.

4. *Variable Frequency Oscillator (VFO) Stability:* Measurement made on VFO frequency stability indicates that about 40 minutes is required to reach a stabilized condition after the power source is connected. After this period the frequency is constant within ± 5 cycles.

A few general observations concerning the receiver may be in order:

1. The mechanical design of the equipment uses the subassembly type of construction with modular construction for the tubes and associated components. The layout can very easily be adapted to printed wiring which would appear to be desirable in the future model design.

2. In this version of the receiver miniature tubes were used in nearly all stages of the receiver. In other versions it would be possible and desirable to use transistors in much of the circuitry. Germanium diodes are used in the present model in the ring demodulators in order to obtain low distortion output in multiple tone operation.

3. Distortion in the audio amplifiers is minimized by the use of negative feedback obtained by omitting bypass condensers for the cathode resistors.

4. Temperature control and voltage regulation of the plate and screen supply voltages are both used to obtain the desired stability in the operation of the variable frequency oscillator (VFO) when used.

The Frequency Standard and the Pulse Locked Generator may be supplied as an integral part of the receiver, or as separate units that may be used for purposes other than operating the receiver. For example, they may be used to control the frequency of a single-sideband transmitter, as a highly accurate signal generator, or for any other application where a highly accurate source of frequencies is required.

The design of this receiver is the result of the joint efforts of the Surface Communications Department of the Defense Manufacturing Division of the Company and the communication scientists of the David Sarnoff Research Center.

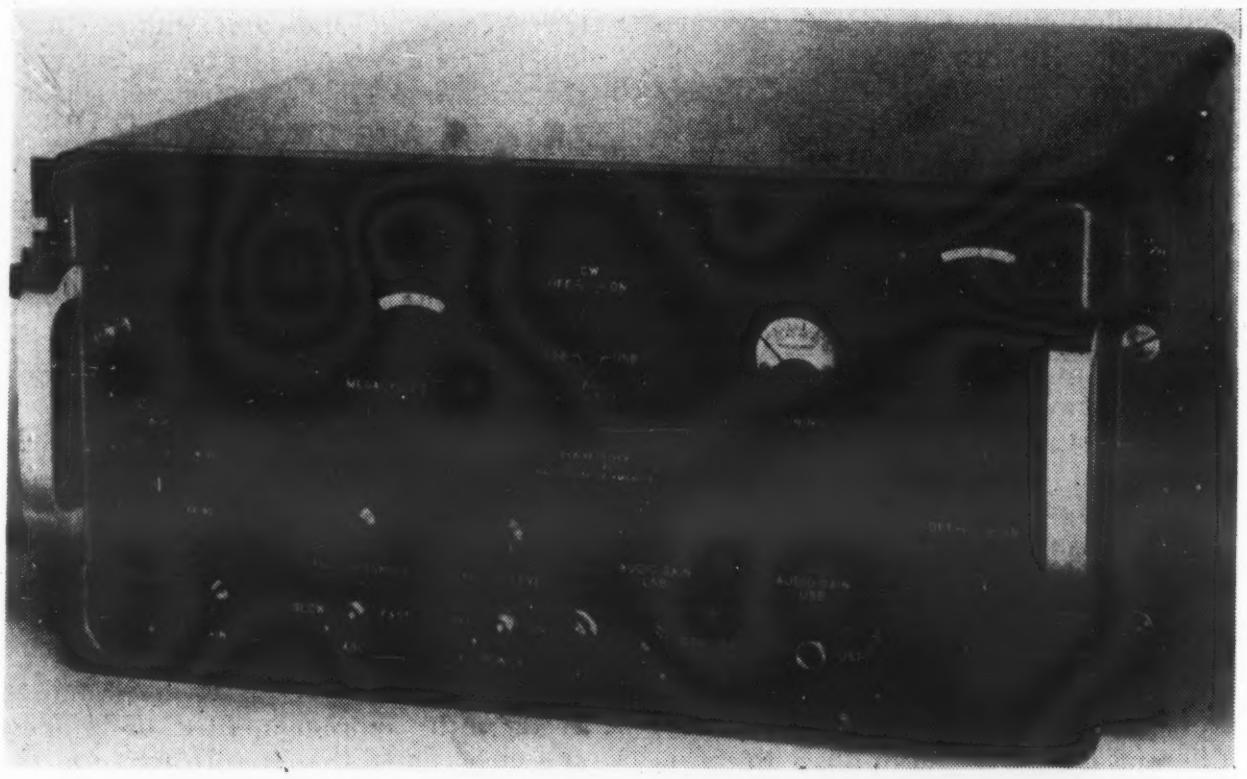


Figure 5

Acknowledgement is made by the author to Mr. I. I. Grasheim and Mr. P. K. Taylor, both of RCA, for their assistance.

A Fully Automatic Teletypewriter Distribution System

by Richard C. Stiles and Leith Johnston, Automatic Electric Co.

THIS PAPER DESCRIBES AN AUTOMATIC teletypewriter distribution system designed and built to meet the requirements of an agency of the government. The system receives teletypewriter messages from many geographically remote points and distributes each message to a number of local and remote stations in the offices of the agency.

Before proceeding with a description of the system, it seems advisable to reflect for a few minutes on the type of communications involved. This system is basically a military teletypewriter system, and as such it operates in a communications network which is subject to many rigorous specifications from both technical and operational standpoints. Automatic Electric Company has previously produced fully automatic teletypewriter switching systems which are at the present time operating in the Signal Corps Army Command and Administrative Network. The first of these was an experimental system installed at Headquarters, Fifth Army in Chicago in 1952, and the next installed in 1956, was a full scale switching center of a production type now in operation at Headquarters, Sixth Army at Davis, California. These systems are successfully switching many thousands of messages daily. Since this system is similar in some respects to these earlier systems, and since it too must operate in military networks, it seems advisable to consider some of its characteristics.

In the military organizations a person who desires to originate a message assigns a definite degree of precedence to the message. This precedence indicator, one of six precedence classifications, remains with the message throughout its handling. Communication personnel attach address or routing indicators, a specified start of message indicator which consists of the character sequence ZCZC, and a specified end of message indicator, and then transmit the message over a teletypewriter channel to the nearest relay point. At the relay point the message is reproduced on paper tape and may or may not be held temporarily, depending upon the availability of circuits toward its destination and the relative degree of precedence of the message. In this way a message may proceed toward its destination through as many relay centers as are required and as transmission facilities are available. The handling of messages at some relay centers is manual, in that operators are required to read the address and precedence indicators and insert the message tape in a suitable transmitter at the proper time. The automatic switching centers, mentioned earlier, accomplish this temporary storage and routing automatically.

It is apparent, then, that in order to insure a high degree of reliability, automatic switching centers for use in military networks must be built to exact specifications. Some of the most important of these are:

(1) They must be capable of switching messages swiftly and accurately.

(2) They must be compatible with all existing networks to the extent that they can be located at any point in a network without the introduction of a similar or special equipment elsewhere in the network.

(3) They must possess a high degree of reliability, since the loss of even a single message in military networks cannot be tolerated. This, of course, is made possible only by an elaborate system of alarms.

(4) They must handle messages in accordance with all six degrees of military precedence, with the provision for interrupting messages of a low precedence for the transmission of one which is extremely urgent.

(5) They must be capable of automatic routing of multiple address messages.

In addition to all of these general features, they must be engineered for ease of operation and supervision by semi-skilled personnel located in various parts of the world.

The type of system discussed in this paper is similar to these military switching centers. It uses similar equipment, receives messages of the same general type, and receives many messages directly from the military networks mentioned earlier. Beyond these few basic similarities, however, there is a radically different concept of operation involved in this system. Here the concept is one of distribution to a number of receiving stations rather than of relaying messages by receiving and retransmitting.

The agency which will be using this system has a requirement for the collection and control of reports of data and statistical analysis. When received, these reports are normally routed to several different offices depending on the subject matter of the report. As an example we can consider the following situation. An office in Chicago may have several reports to transmit to the control agency. One may concern the total dollar volume of business handled the preceding day. We may say that a report of this kind must be routed to five different offices in the agency headquarters, although this fact may be unknown to the originator of the report in Chicago. Another report from this office might concern a breakdown of the day's business into dollar volume quantities of several individual products. A report of this nature might be routed to fourteen different offices, some of which may have been included in the distribution pattern for the report on the overall dollar volume. In all cases the originator of the report need not know the type of distribution involved. It is readily apparent that if such a system is used the patterns of distribution can be changed at will by the home office without informing the field.

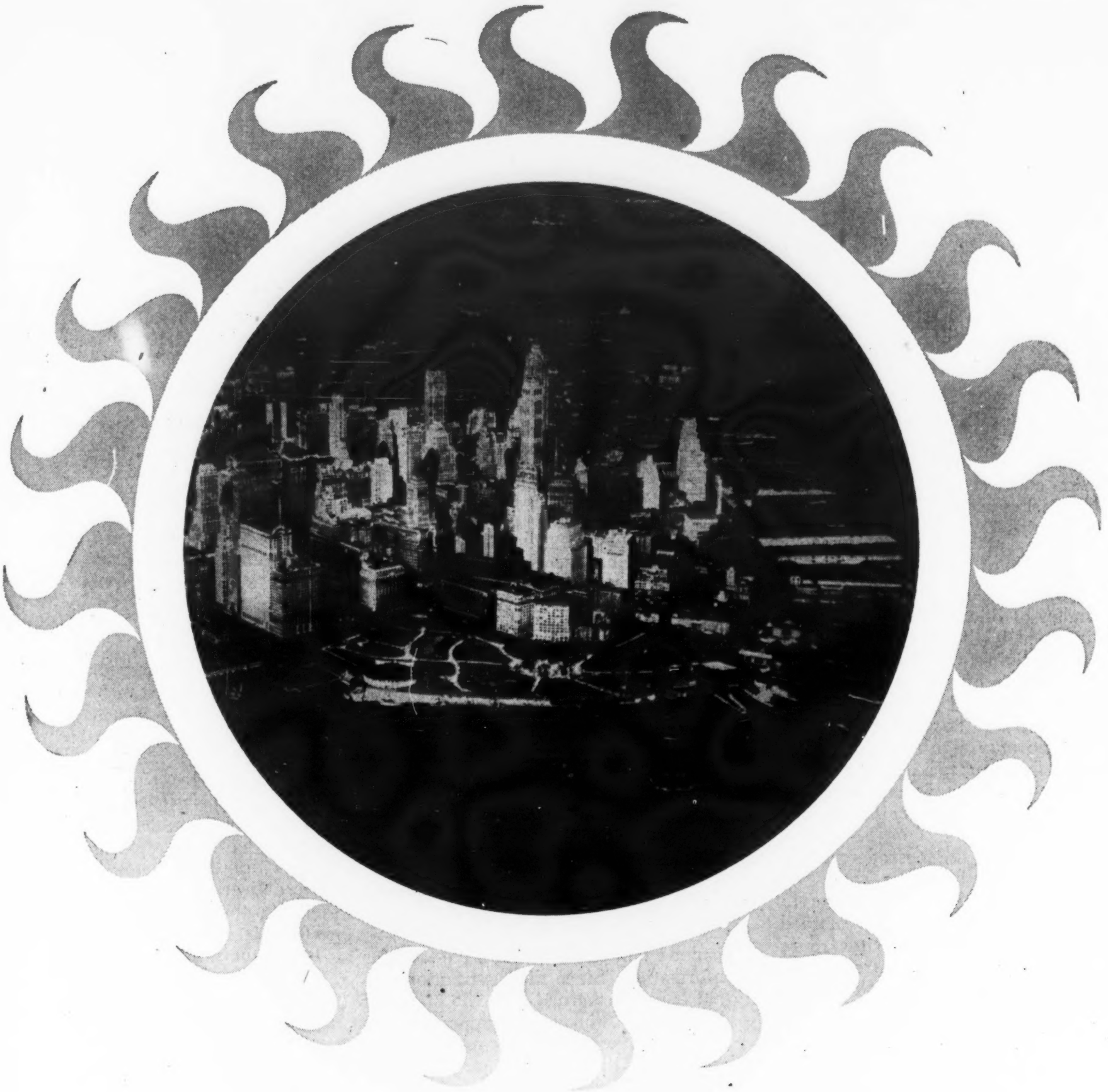
In order to understand the operation of the system, we must consider the type of network and the general characteristics of the message to be handled. In the network under consideration, the control agency is at the hub of the network with all circuits leading in toward the agency. In those cases where relay centers are used they may be operated by one of the three military services and may contain automatic switching equipment of the type previously referred to.

In a typical message handled by this system, the address contains a two letter precedence indicator and a three letter group which identifies the subject matter of the message, as shown:

```
ZKZK RR ABC DE XYZ 005A
  051643Z              (2CR)(LF)
T E X T                (2CR)(8LF)
NNNN
```

Note also that there is a sequence of characters which identifies the end of the message. The three letter group which identifies the subject matter is called a Delivery Distribution Indicator, abbreviated DDI. The message originator knows only that the DDI, consisting of the letters ABC, will identify a message concerning the day's total dollar volume.

This is the basic message format required for distribution of the reports. It is quite another matter to address the message so that it will arrive at the control agency for distribution.



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Below is shown the same message with a special prefix attached to the message which will permit this routing.

```
ZCZCAAA(FIGS)101
  (LTRS)CDE254      (2CR)(LF)
RR RUEPAB           (2CR)(LF)
DE RUWPAB           (2CR)(LF)
ZKZK RR ABC DE XYZ
  005A 051643Z      (2CR)(LF)
T E X T             (2CR)(8LF)
NNNN
```

In the above example, the ZCZC is the start of message indicator recognized in the service networks. The automatic equipment in use in the network requires this symbol for proper message handling. The next sequence of three letters and three numbers identifies the channel and serial number of transmission over which the message was transmitted as it arrived at the distribution center. Please note that there is more than one set of channel number designations depending upon the number of line transmissions which were involved in the message transmission from origin to destination. Since one of these sets of channel designation and number is added for each transmission, the first set appearing after the ZCZC is the only significant one. The serial number appearing in the significant set must be verified automatically to insure continuity of message traffic.

The next line of the message contains the precedence indicator and the routing indicator. The precedence indicator has been previously explained. The six letter routing indicator represents the address of our control agency within the military network. This indicator will cause the message to find its way through the service networks for delivery to the Teletypewriter Distribution System. The next line of the message identifies the routing indicator or address of the message originator. Thus it can be seen that the first two lines are required to cause the message to be delivered to the distribution system.

Nearly all messages handled by the system must be delivered to several distribution points or offices. It is apparent that some offices will receive a higher volume of traffic than others, and thus they will be equipped with a greater number of page printers or other receiving devices. Most of the stations are located in the same area, but a small number of offices are located at remote points and will require special treatment which will be described later.

We may proceed now to a description of the system operation.

As a message arrives at one of the incoming lines over a teletypewriter channel, it is reproduced by a typing reperforator in a paper tape. The message is typed on the tape for the convenience of operators and each character is perforated in the standard five unit "Baudot" code. As the message accumulates, the tape reader automatically starts to read the tape, hunting for the letter Z. When this letter has been detected, a sequence register is activated which acts to register the reading of the sequence ZCZC. If the sequence is not perfect a fault will be indicated. You will recall that the sequence ZCZC is the start of message indicator. The receipt of this sequence conditions a second register to receive a figure shift function, which must precede the first numerical digit. When the figures shift character is received it prepares a register circuit which records the three digits of the channel number. Each digit of the channel number must be verified against a corresponding digit in a rotary switch register. The rotary switch register keeps a record of all message numbers received and advances the register once for each message received. Each digit of the channel serial number of the message being received must be verified. Failure to verify any digit results in an immediate alarm and temporary stoppage of message processing. After personal attention by an operator the message may be permitted to proceed. This process constitutes a channel number check and need be accomplished for only the first set of channel numbers on the message.

You will recall that the first three lines of the incoming message contained information required to deliver the message to the distribution system and we have used at least a portion of the first line to identify the message and to check the channel number. After the number has been checked the tape reader again scans the message tape for information. Since the distribution system is not concerned with the origin of the message, the next significant characters are those in the sequence which appear in the fourth line. This sequence identifies the start of significant distribution information, so that the ZKZK is recorded in a register. At this point the incoming line circuit causes the tape reader to stop and also requests the services of a Director. In this system connections are established by use of a Director which receives routing information, determines proper connections and withdraws from an established connection during message transmission. The Directors of this system are pooled so that a set of two Directors are assigned to work with a group of 25 incoming lines. In response to the demand for service from an incoming line circuit, an idle Director finds the calling incoming line and takes over control of the tape reader in the line equipment. Under control of the Director the tape reader continues to scan the incoming tape and the characters read by the reader feed into the Director. You will recall that the first characters appearing after the ZKZK are those of the precedence indicator. These are stored on relays in the Director for future use. The tape reader continues and the three characters of the DDI are recorded in the Director. At this point the tape reader is stopped to permit the Director equipment to process the DDI.

Processing of this delivery indicator includes as a first step a translation process. For this purpose the Director calls for the translator unit which is available to all Directors in the system. When the translator has been assigned, the DDI is transferred from the Director into the translator. Within 50 milliseconds the translator returns an indication to the Director of one station involved in this delivery indication. The translator then releases from the Director. Having obtained this station indication, the Director must find an available printer at the designated station and prepare it for use. This is accomplished by a series of tests in which the Director makes use of the terminal finder unit. When a suitable page printer has been seized it is placed under control of the incoming line circuit by action of its associated incoming selector switch and held for future use. Following this, the Director again demands the services of the translator unit and again transfers the delivery indicator into the translator. The translator in this case returns to the Director an indication of the second station involved in this indicator. In response to this, a page printer associated with the second station is seized and held in the same manner as the first printer. Following this action the Director repeats this process until all stations of the delivery indicator have been selected. As the last station of the indicator is being indicated to the Director the translator informs the Director that no further translations are required for this delivery indicator.

When the Director has selected a printer associated with the last station, the tape reader again is permitted to read the tape. A delivery indicator may contain a maximum of 10 stations. Therefore, if more than 10 are desired, the message must include two or more delivery indicators similar to the first. After finishing processing of the first indicator a second may be read by the tape reader. If so, it is processed similarly to the first and additional page printers are selected and held for further use.

After completion of processing of the last delivery indicator the tape reader again continues to read the tape. The next significant characters are those of the sequence DE, which indicates to the switching equipment that no further processing is required. When this sequence has been recorded in the register of the Director, a signal is sent from the Director to the incoming line control relay circuit which then takes over control of all associated page printers. At this point the Director releases from the connection and is immediately available for service to another line. The line circuit then remains associated with the selected page printers and transmission of the mes-

sage begins from the transmitter at the incoming line position directly to the several associated page printers. The entire message is transmitted to all stations.

Although the process just described is the basic plan of the system, there are many interesting sidelights, some of which are worthy of note here. You will recall that the page printers of this system are all located at a control agency headquarters. There are actually over 400 of these page printers and all are located within the confines of one building. As was mentioned earlier, since some of the stations require a heavy traffic volume they must be equipped with several printers. It is the job of the switching equipment to select an idle printer from the group at any one station. This is accomplished by 50 point selector switches in the terminal finder unit and by a distribution terminal control relay group in the distribution terminal unit. There is one control relay group associated with each page printer.

One might ask, "What will happen if all printers at one station are busy when a new message arrives?" The traffic of the system has been estimated accurately and sufficient printers have been planned for each station to insure that such an occurrence will be very unlikely. However, it must be realized that it could happen. Since an incoming line circuit must hold all selected printers until all required printers are available, it was deemed inadvisable to plan on holding them for any great length of time. Accordingly a feature has been added to the system which will cause such an overflow condition to result in the selection of a message storage unit into which a message for any station may be placed temporarily awaiting an available page printer at the busy station. In this way unnecessary holding of printers at other stations is eliminated. These temporary storage units are called cross office units and they are pooled together such that any one of them may be temporarily associated with any incoming line and with any station. A message which is directed into one of these cross office units will wait until a line to the desired destination is available and then will be transmitted to the station by way of the distribution terminal unit. Selection of an incoming line and a station is accomplished for the cross office units by the action of the Director in the initial action on the message. Actual control of transmission from the cross office unit, however, is by way of control circuits within the cross office control relay assembly.

The cross office pool has other uses, which we would like to elaborate on. Because the printers are located within the same building with the distribution system equipment, the transmission facilities to these points can be rigidly controlled and will be very reliable. For this reason it is deemed unnecessary to report to numbering messages from the distribution equipment to the local station. However, there are a few stations which are not located in the same building, and thus transmission to these stations must be handled by either commercial or military land line or radio circuits. Since these transmission facilities cannot be controlled by the agency it was considered necessary to number messages to these points. A message to one of these points will be directed to temporary storage in a cross office unit. The unit will have its outgoing selector switch positioned to the desired line by the Director. Those terminals on the banks of the outgoing selector switches which are assigned to those remote points will be connected to line monitor equipment. This equipment consists of a monitor reperforator, a transmitter, automatic numbering equipment, and the necessary relay control circuits. The monitor records on perforated tape all transmissions to the particular line, and this record can be used to re-run specified messages. The numbering equipment automatically supplies a serial number to each outgoing message. These numbers can be manually verified at the remote point to insure sequential continuity. The numbers, channel designation, and other pertinent information are transmitted to the line by the transmitter which can be controlled by the number registers and the associated circuitry. In operation, when a cross office unit has a message ready for transmission to a remote point it demands control of the outgoing line. If the line is idle it may be assigned to the particular cross office unit for control. After seizure the transmitter in the line circuit sends out the channel designation and serial number. Following this the body of the message is transmitted to the line directly from the transmitter in the cross office unit. While a message is being transmitted to this line, other messages may accumulate for this line in various cross office units. When the line becomes idle all waiting cross office units demand the line and only the one carrying the highest degree of precedence will gain control of the line.

Another very important use for the cross office pool is its facility for handling high precedence messages in an overflow condition. As was mentioned earlier, if a message requires a printer at a station which has all of its printers busy, a cross office unit may be seized to store the copy of the message which is destined for the busy station. The military concept of precedence requires that messages of the two highest degrees of precedence must cause interruption of a message of lower precedence, if necessary. Obviously unless there is an overflow condition this automatic interruption would not be required. If, however, a high precedence message is directed to a cross office unit due to an overflow condition, an interruption may be required.

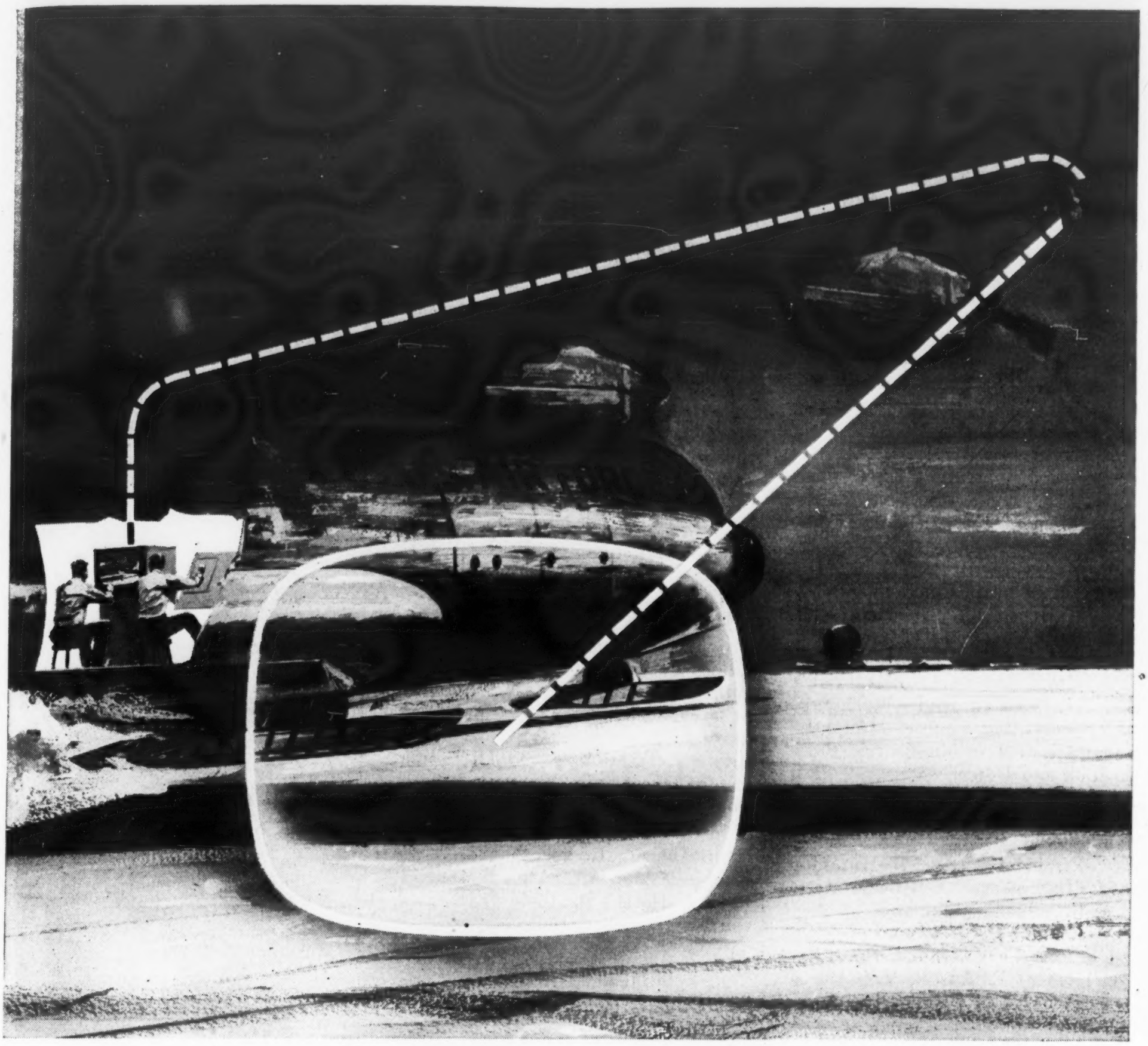
When a high precedence message arrives at a cross office unit and is ready for transmission to a local station, the control circuits of the cross office unit examine the degree of precedence of one of the lines to a given station. Should it be lower than that of the message in storage, a decision to interrupt is made and a signal is sent from the cross office unit by way of the distribution terminal convertor unit, the distribution terminal unit, and the incoming selector switch unit back into the incoming line unit which is transmitting the low precedence message. This signal causes transmission to cease immediately to all connected stations and then causes a special cancellation sequence to be sent to all stations. This sequence advises operating personnel that the message is incomplete and that the complete message will follow later. After this is accomplished the original connection is released and the cross office unit is permitted to send its high precedence message. An operator is summoned by alarm lamps to the incoming line transmitter to pull tape back and re-start the interrupted message. It should be apparent that this feature is extremely important.

The system is very thoroughly interlaced with alarms and other safeguards to prevent loss of a message. Messages which arrive at the distribution system without sufficient distribution information are routed to special intercept positions so that an operator can repair the message tapes or take other corrective action.

One example of the thoroughness of the alarm system is the provision for immediately stopping transmission to a station if a printer at that station is not feeding paper properly.

As we have pointed out, the distribution plan can be controlled by the control agency without informing the field. As an example, consider the possible change of plans which might occur each day at 5 o'clock when office personnel are leaving for the day. Under these conditions an entirely different type of distribution plan might be used after 5 o'clock. This is accomplished in the equipment in a few seconds by removing one strapping plug board from the translator unit and replacing it with one which carries an entirely different type of distribution plan.

This system is undergoing installation testing at the present time and will be put into service later this year. Although it is being installed for a specialized application, it must be realized that other uses for a system of this type can be found in business and industry. It would seem that wherever a large volume of reports or other written communications are to be funneled down to a centralized agency for local distribution or where such information must be channeled to automatic business machines, a system of this type could be used.



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Association affairs

NEW AFCEA OFFICERS AND DIRECTORS

The following Officers were elected at the annual Council and Board of Directors meetings during the National Convention. President—Frederick R. Furth, Rear Adm., USN (Ret.), Director of Research and Development, International Telephone and Telegraph Corp. 1st VP—Maj. Gen. Alvin L. Pachynski, USAF, Director of Communications-Electronics, USAF. 2nd VP—Maj. Gen. James D. O'Connell, USA, Chief Signal Officer of the Army. 3rd VP—Rear Adm. Henry C. Bruton, USN, Director of Naval Communications. 4th VP—Joseph E. Heinrich, staff supervisor, American Telephone and Telegraph Co., Long Lines Dept. 5th VP—John R. Howland, General Sales Manager, Dage TV Division, Thompson Products, Inc. Counsel—Ralph L. Walker, partner in law firm of Pierson, Ball and Dowd.

The following Directors were elected to serve until 1961: Raymond C. Maude, Maj. Gen., USAF (Ret.), Vice President, Allen B. DuMont Labs., Inc.; Percy G. Black, Asst. Vice President, Automatic Electric Co.; Roland C. Davies, Publisher and Editor, *Telecommunications Reports;* Harry E. Austin, Vice President in charge of Pacific Coast District, RCA Communications; Edward K. Foster, Vice President and General Manager, Bendix Radio Div., Bendix Aviation Corp.; Francis H. Lanahan, Maj. Gen., USA (Ret.), President, Federal Electric Corp.; Joseph R. Redman, Rear Adm., USN (Ret.), Vice President, Western Union Telegraph Co.; Robert C. Sprague, Chairman of the Board, Sprague Electric Co.; W. Walter Watts, Executive Vice President, Defense Electronic Products, Radio Corp. of America; Frank W. Wozencraft, Washington attorney.

AFCEA Honor Awards

Ten officers graduating with top honors from courses at the U.S. Army Signal School were recently presented the AFCEA award for outstanding scholastic achievement.

The five men who were in the Signal Officers Basic Course were: 2nd Lt. E. W. Summerford, Hartselle, Ala. and 2nd Lt. P. A. Watts, Birmingham, Ala.; both studied at Alabama Polytechnic Institute; 2nd Lt. V. L. Anderson, Mabton, Wash., an agricultural engineering student at State College of Washington; 1st Lt. R. M. Johnson, Brooklyn, N. Y. and 2nd Lt. W. F. Colescott, Monterey, Calif., a graduate of the University of California.

2nd Lt. D. M. Keith, Chicago, Ill., a graduate of the University of Wisconsin, scored highest in the Communication Center Operation Officer Course.

In the Signal Supply Officer Advanced Course, Capt. R. F. Prael, New York City, took the number one spot.

Honor man in the Signal Material Maintenance Officer Course was Chief Warrant Officer Ely Kastenbaum, Far Rockaway, N. Y.; 2nd Lt. J. A. Weatherman, Charlotte, No. Carolina, a graduate of Georgia Institute of Technology, scored highest in the Electronic Warfare Officer Course.

In the Field and Fixed Station Radio Officers' Course, 2nd Lt. J. M. Robbins, Malvern, Ark., took top honors. He is a graduate of Henderson State Teachers College.

Introducing AFCEA's New Group Member

The AFCEA greeted the Ramo-Wooldridge Corp. of Los Angeles, California, as a new group member in June. Ramo-Wooldridge is one of the large and important electronic firms in the Los Angeles area, concerned with the research and development of advanced electronic systems.

The members of the firm who will be company representatives in AFCEA are: Wiley V. Conover, Washington Representative; G. W. Fenimore, Director, Electronic Instrumentation Division; W. B. Hebenstreit, Director, Computer Systems Division; A. B. Hunter, Dayton Representative; George E. James, Director, Boston Division; M. H. Jennings, Boston Representative; J. F. Manildi, Director, Market Research; Burton F. Miller, Director, Communications Division; Milton E. Mohr, Director, Control Systems Division; William M. Richardson, Washington Representative.

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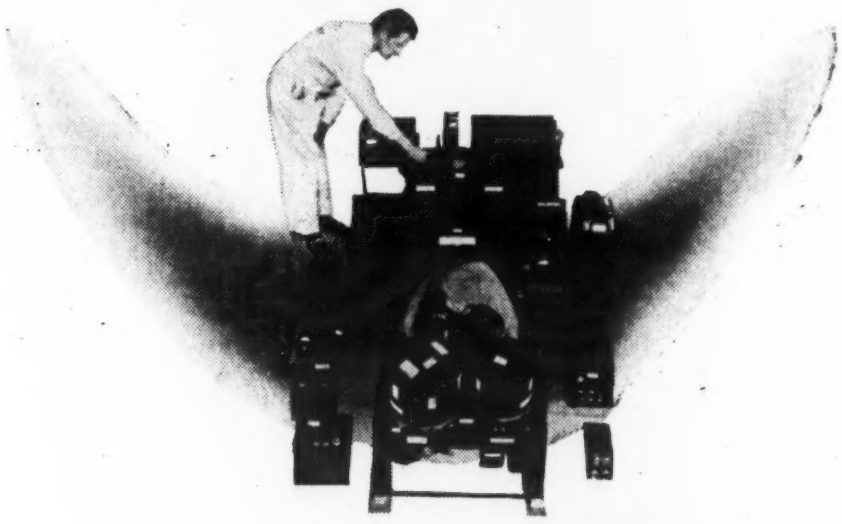

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Communications—Electronics—Photography

Listed below are the firms who are group members of the Armed Forces Communications and Electronics Association. By their membership they indicate their readiness for their share in industry's part in national security. Each firm nominates several of its key employees or officials for individual membership in AFCEA, thus forming a group of the highest trained men in the electronics and photographic fields, available for advice and assistance to the armed services on research, development, manufacturing, procurement, and operation.

Admiral Corp.
Aircraft Radio Corp.
Allied Control Co., Inc.
Allied Radio Corp.
American Cable & Radio Corp.
American Electronic Laboratories, Inc.
American Institute of Electrical Engineers
American Machine & Foundry Co.
American Radio Relay League
American Telephone & Telegraph Co.
American Telephone & Telegraph Co., Long Lines Dept.
Ampex Corp.
Amphenol Electronics Corp.
Anaconda Wire & Cable Co.
A. R. F. Products, Inc.
Arnold Engineering Co.
Atlas Precision Products Co.
Automatic Electric Co.
Automatic Electric Sales Corp.
Automatic Telephone & Electric Co., Ltd.
Barker & Williamson, Inc.
Barry Controls, Inc.
Bell & Gossett Co.
Bell Telephone Company of Pa.
Bell Telephone Laboratories, Inc.
Bendix Radio Division, Bendix Aviation Corp.
Blackburn Electronic Corp.
Bliley Electric Co.
Bomac Laboratories, Inc.
British Thomson-Houston Co., Ltd.
Bruno-New York Industries Corp.
Burroughs Corp.
California Water & Telephone Co.
Cambridge Thermionic Corp.
Capitol Radio Engineering Institute, Inc.
Carolina Telephone & Telegraph Co.
Central Technical Institute
Chesapeake & Potomac Tel. Co.
Cincinnati & Suburban Bell Tel. Co.
Collins Radio Co.
Columbia Broadcasting System, Inc.
Compagnie Francaise Thomson-Houston
Contraves Italiana
Convair, Division of General Dynamics Corp.
Cook Electric Co.
Copperweld Steel Co.
Cornell-Dubilier Electric Corp.
Craig Systems, Inc.
Crosley Division-Avco Mfg. Corp.
Dana, P. A., Inc.
Designers for Industry, Inc.
DeVry Technical Institute
Diamond State Telephone Co.
Dictaphone Corp.
DuKane Corp.
DuMont, Allen B., Laboratories, Inc.
Eastman Kodak Co.
Electronic Associates, Inc.
Electronic Communications, Inc.
Elgin Metalformers Corp.
Fairchild Camera & Instrument Corp.
Farnsworth Electronics Co.
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Gray Manufacturing Co.
Hallamore Electronics Co.
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Hallicrafters Co., The
Haloid Co.
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International Business Machines
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New York Telephone Co.
North Electric Co.
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Times Facsimile Corp.
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Trad Electronics Corp.
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Triad Transformer Corp.
Tung-Sol Electric, Inc.
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Waterman Products Co., Inc.
Webster-Chicago Corp., Government Division
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Western Electric Co., Inc.
Western Union Telegraph Co.
Westinghouse Electric Corp.
Weston Electrical Instrument Corp.
Wheelock Signals, Inc.
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PHILADELPHIA: Pres.—William F. Powell, Jr., Bell Telephone Co., 1835 Arch St. Sec.—Robert G. Swift, Diamond State Telephone Co., 121 N. Broad St.

PHILIPPINE: Pres.—Maj. Ted E. Reger, SAMAP, APO 74, S. F. Sec.—Jack Walsh, Philco Gen. Del., APO 74, S. F.

PITTSBURGH: Pres.—H. W. Mitchell, Bell Telephone Co., 1001 Liberty Ave. Sec.—H. W. Shepard, Jr., 386 Arden Road.

ROCKY MOUNTAIN: Pres.—Byron E. Thady, Mountain States Tel. Co., 17 N. Weber, Colorado Springs, Colo. Sec.—Capt. Francis D. Tappin, USAF Hq. ADC, Ent AFB, Colo.

ROME: Pres.—Maj. William B. Bodine, Army Sec. MAAG, APO 794, N. Y. Sec.—John E. Colarusso, MAAG Army, APO 794, N. Y.

ROME-UTICA: Pres.—Allan A. Kunze, Lee Center, N. Y. Sec.—Darrell S. Kirby, 904 Floyd Ave., Rome, N. Y.

SACRAMENTO: Pres.—Lt. Col. Clarence M. Godfrey, Sacramento Signal Depot. Sec.—Capt. Robert McMorrow, 951 La Sierra Drive.

SAN FRANCISCO: Pres. — S. N. Barton, Mackay Radio, P. O. Box 1241, Palo Alto, Calif. Sec.—Karel W. Goossens, Pacific T&T Co., 140 New Montgomery St.

SAN JUAN: Pres.—Wyman S. Borden, P. R. Tel. Co., Box 4275, San Juan, P. R. Sec.—Albert Crumley, Radio Corp. of P. R., P. O. Box 10073, Caparra Heights, P. R.

SCOTT-ST. LOUIS: Pres.—Col. Charles W. Gordon, 3310 TTGrp Cmdr., Scott AFB, Ill. Sec.—Allan L. Eisenmayer, P.O. Box 456, Trenton, Ill.

SEATTLE: Pres.—Raymond J. Laine, 521 E. 123rd Sec.—Merrill R. Stiles, 916 W. 122nd.

SOUTH CAROLINA: Pres.—Cmdr. H. C. Rodin, Bldg. 10, Charleston Naval Shipyard, Charleston. Sec.—F. L. Davis, Southern Bell T&T Co., Owen Bldg., Columbia.

SOUTH TEXAS: Pres.—Col. Albert H. Snider, 1822 AACS Group, Randolph AFB, Tex. Sec.—S. J. Keane, Southwest Research Institute, Box 2296, San Antonio.

SOUTHERN CALIFORNIA: Pres.—Charles A. LaHar, RCA Victor Div., 1560 N. Vine St., Hollywood. Sec.—Jack Warner, Jr., 4000 Warner Blvd., Burbank.

SOUTHERN CONNECTICUT: Pres. — Edwin B. Hurley, So. New England Tel. Co., Box 1562, New Haven. Sec.—J. A. Leopold, Dictaphone Corp., 375 Howard Ave., Bridgeport.

SWITZERLAND: Pres. — William P. Lear, Lear Radio, Geneva; Sec. — Robert V. Lindsey, Intl. Telecommunications Union, Geneva.

TINKER-OKLAHOMA CITY: Pres.—Loyd G. Dorsett, Dorsett Labs., Inc., Norman. Sec—Col. William L. Gregory, 1800 AACS Wing, Tinker AFB.

TOKYO: Pres.—James T. Ramsey, Hq. FEAF ,Box 228, APO 925, S. F. Sec.—Paul W Becker, SigO, AFFE-8A Rear, APO 343, S.F.

WASHINGTON: Pres.—L. Harriss Robinson, Motorola, Inc., 1145 19th St., N.W. Sec.—Ralph Irwin, Westinghouse Electric Co., 1625 K St., N.W.

U. S. Air Force Photo

Designed basically for night photographic work, the Martin RB-57 is employed by USAF TAC, powered by two Wright J-65 jet engines.

WADC'S WEAPONS GUIDANCE LABORATORY GIVES ACCURACY TO AIR FORCE BOMBS, MISSILES AND AIRCRAFT

The Weapons Guidance Laboratory at the Air Research and Development Command's Wright Air Development Center performs applied research and development of all Air Force weapons guidance equipment.

Included under this broad category are airborne bombing systems and equipment, weapon defense systems, offensive fire control systems, missile guidance equipment, electronic jamming systems, chaff systems, navigation systems, manual navigation aids and special test equipment peculiar to the requirements of the weapons guidance systems or equipment. In addition, all components of the foregoing are the province of this laboratory. The facilities available for these studies include various gun ranges, temperature and altitude chambers and other specialized test and evaluation installations.

Weapons Guidance is one of the laboratories that form the Wright Air Development Center. WADC, in turn, is the largest Center under the Air Research and Development Command. At its location at Wright-Patterson Air Force Base, Ohio, upward of 10,000 military and civilian workers are engaged in research, development and testing of aircraft, guided missiles and all types of associated flight and ground equipment.

Chapter News

Augusta-Fort Gordon—Shown during the May meeting are, left to right: Joe S. Stone, Vice Pres., Southern Bell T&T Co.; Col. Clarence R. Dunlap, Chief of Personnel and Admin. Div., USASTC, Fort Gordon; Col. Thomas A. Pitcher, Chief of Staff, USASTC; guest speaker George M. Dean, Asst. Vice Pres., AT&T Co., and Col. Braxton E. Small, chapter president.

Augusta-Fort Gordon

George M. Dean, Assistant Vice President of the American Telephone and Telegraph Company, New York, was guest speaker at the chapter's May 16th meeting and described some of the measures being taken by AT&T to strengthen this Nation's "military posture."

After a brief explanation of the AT&T system, Mr. Dean told the members of the defense role that could be played by "by-pass routes" now being installed around populous cities. The system will enable telephone calls to pass around, instead of having to go through, congested areas.

"We are ringing the biggest cities," he said, "at a cost to our investors of some $100,000,000. While this arrangement will have some beneficial effect on normal peace-time telephone use, it is primarily a defense measure to insure continued service, if this country is ever attacked by enemy bombers."

The AT&T executive estimated that if the Nation were to "become a battle ground" only about 20 per cent of normal civilian telephone traffic could be maintained. The emphasis, he said, would be only on military and emergency service calls.

Mr. Dean also discussed the installation of the "advance warning" radar network being strung across the top of the North American continent by Western Electric Company, an AT&T subsidiary. He described it as a "terribly difficult job."

Among the visiting guests were Charles M. Eberhart, president of AFCEA's Atlanta Chapter, and Joe S. Stone, Vice President, Southern Bell Telephone & Telegraph Company. Col. Braxton E. Small, chapter president, served as host.

Chicago

The Navy Electronics Supply Office, Great Lakes, was the scene of the May 27th chapter meeting.

Principal speaker was Capt. Richard S. Mandelkorn, Commanding Officer and Director of the U. S. Naval Radiological Defense Laboratory, San Francisco, whose subject was "The Problem of Living with the Atom."

Host for the occasion was Capt. H. J. Goldberg, Supply Corps, U. S. Navy, Commanding Officer of the Electronics Supply Office and a Director of the Chicago Chapter.

The chapter's April 25th meeting was addressed by Hardy G. Ross, Project Manager of DEW Line for Western Electric Company. He supplemented his talk with a color sound film and slides which gave the audience a vivid picture of the construction and installation problems encountered in establishing the radar chain in the wilderness of the Arctic Circle.

Detroit

The Burroughs Corporation, group member of the AFCEA, hosted the chapter at its Tireman Plant in Detroit on May 10th.

Following luncheon in the plant dining room, Harry B. Rottiers, Director of Defense Contracts for Burroughs and host for the meeting, called the group to order and introduced Tireman Plant Manager Ed W. Schening, who briefly explained the electronic nature of the factory.

The audience then was divided into small groups and given an extensive guided tour of the plant which was recently doubled in capacity to handle new precision production requirements for a new classified Ballistic Missile contract. The tour covered various production stages of the AN/FST-2 Coordinate Data Transmitting System, Burroughs' contribution to the USAF SAGE continental air defense system. Included was a close inspection of the automatic printed circuit equipment, essential to the production of the plug-in cards for the T-2 data processing system.

The chapter reports the visit left little doubt as to the significance of electronic data processing and computer equipment to modern defense and the important position Burroughs holds in the field.

During the business session, the chapter's annual elections were held and the following officers were chosen for 1957-58: president—Col. James I. Vanderhoof, Commander, 30th Air Division; vice presidents—Harry B. Rottiers, Burroughs Corporation; R. A. Berkfield, Michigan Bell Telephone Co.; A. A. Minowitz, Rett Products Co.; treasurer—J. H. White, Michigan Bell; assistant treasurer—K. C. Crumb, Michigan Bell; secretary—J. R. Saxton, Michigan Bell; assistant secretary—H. A. Dawson, Michigan Bell.

Fort Monmouth

Col. Robert B. Tomlinson, director of the Signal Equipment Support Agency, was elected president of the chapter during the annual elections on May 17th.

Other officers named were: vice

Chicago—Chapter officers are pictured with their hosts at the Navy Electronics Supply Office on May 27th. Left to right: front row—James F. Weldon, secretary; G. R. Haase, director; Henry J. McDonald, president; Col. A. N. Niemi, director; second row—Col. Melvin Kernkamp, director; Captains H. F. Kuehl, H. J. Goldberg, Richard S. Mandelkorn and M. H. Gluntz of the Electronics Supply Office, and Carrington H. Stone, vice president.

"An infinite capacity for taking pains"

The above familiar phrase is usually given as a definition of genius. We borrow it as a job description.

The lengths to which our Quality Control people go, to insure the reliability of our complex products, are truly painstaking, and are applied equally to components we make ourselves and those we purchase from outside suppliers.

For example, consider vacuum tubes, the heart of hundreds of projects in our Electronics Division. No spot check satisfies here (even if that's all our customer specifies)—but a whole series of critical tests, including such precise evaluations as these:

Inspection of tube characteristics to rigid Stromberg-Carlson specifications—performed on special equipment which can do in a half-hour what would take days on conventional testing devices.

Inspection by X-ray, looking for deeply hidden potential faults which could cause malfunction at any time after first use.

Inspection by microscope, seeking welding faults, minute cracks in glass, and even infinitesimal loose particles inside the tube.

And tubes are only one concern. *All* components must pass similarly rigid tests, to assure operating performance, ruggedness and reliability in the completed equipment.

You can't put a price on "taking infinite pains." You *can* place your confidence in a company where this is everyday procedure.

STROMBERG-CARLSON COMPANY

A DIVISION OF GENERAL DYNAMICS CORPORATION

General Offices and Factories at Rochester, N. Y.—West Coast plants at San Diego and Los Angeles, Calif.

CHAPTER NEWS

presidents—Halsey F. Hubbard, Equipment Support Agency; Norman Freeman, Stromberg-Carlson Company; secretary—Harry C. Ross, Equipment Support Agency; treasurer—Esther M. Ipri, The Signal School.

Directors selected were: Arthur L. Adamson, Col. Olin L. Bell (retiring president), Brig. Gen. Earle F. Cook, Col. Fred J. Elser, Raymond L. Gilbarte, Col. Joseph E. Heinrich, Brig. Gen. Stuart S. Hoff, J. Peter Hoffman, Edward F. Kolar, Col. Paul O. Langguth, Lt. Col. J. P. McGovern and Harry Sundermeyer.

A dinner-dance at Gibbs Hall Officers' Club followed the business session.

Gulf Coast

Election of officers was the main item of business at the May 6th dinner meeting. Ancil Z. Arseneau, Keesler Air Force Base, was chosen to head the chapter during 1957-58.

The other new officers are: vice president—George D. Sheffield, Southern Bell Telephone and Telegraph Co.; secretary—Joseph A. O'Connell, Southern Bell Telephone and Telegraph Co.; treasurer—Donald E. Payne, Keesler Air Force Base.

The chapter extended a vote of thanks to Maj. Don L. Poling, outgoing president, for his leadership during the past year.

Program feature of the meeting was the Bell System film, "Voices Beneath the Sea," which describes the laying of the Trans-Atlantic telephone cable.

Korean

Chapter members and guests met at the Chosen Hotel in Seoul on April 26th. Among the sixty-five present were Korean Minister of Communications E. J. Lee and the newly appointed Vice Minister of Communications, Maj. Gen. E. T. Cho (Ret.).

Following dinner, the group was taken on a conducted tour of the Seoul Central Telephone Exchange by Korean Ministry of Communications personnel.

Detroit—Annual elections were held on May 10th. Shown above are the new president, Col. James I. Vanderhoof, USAF, and the new first vice president, Harry B. Rottiers of the Burroughs Corporation which was host to the chapter for this meeting.

San Francisco

The regular bi-monthly meeting was held at the Algiers Restaurant in Redwood City on May 16th.

Fort Monmouth—Col. Olin L. Bell, retiring chapter president (left center), congratulates his successor, Col. Robert B. Tomlinson, following the May 17th elections. At extreme left is Norman Freeman, new second vice-president, and at right, Harry C. Ross, new secretary.

Following dinner, the seventy-five members and guests visited the trans-Pacific radio transmitting station of Mackay Radio and Telegraph Company at Palo Alto for a conducted tour of the facilities. The station handles the overseas and ship-to-shore radio services to points in and beyond the Pacific Area, using over twenty radio transmitters which are arranged for twinplex and poliplex operation.

The late departure of the visitors, many of whom had never seen a major trans-oceanic radio-telegraph station before, attested to the program interest.

San Juan

Each of the last two meetings were in honor of a charter chapter member who was being transferred. The dinner-meetings took place at the Officers' Club, Fort Brooke.

Tribute was paid on April 25th to Arthur T. Cline, Engineer-in-Charge of the FCC Office in San Juan, who was being transferred to Atlanta as head of the FCC Regional Office in that area; and on May 23rd to Paul A. Girard, President of the Radio Corporation of Puerto Rico and a former president of the chapter, who was leaving for Rio de Janeiro to be Manager of RADIONAL, the Brazilian affiliate of IT&T.

The annual elections brought the following into office for 1957-58: president—Wyman S. Borden, Puerto Rico Telephone Company; vice-president—Capt. Gifford Grange, USN, commanding officer, Naval Communications Station; secretary—Albert R. Crumley, Jr., Radio Corporation of Puerto Rico;

Korean—The Korean Ministry of Communications conducted the program for the April 26th meeting in Seoul. Left to right are: Mr. E. J. Lee, Minister of Communications; Col. Walter E. Letz, Jr., chapter president; and Maj. Gen. (Ret.) E. T. Cho, Vice Minister of Communications.

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treasurer—Jose A. Pabon, Insular Police Communications Department.

Directors: Felix Gros, Civil Aeronautics Administration; Kinne Prachel, Prachel's Radio & TV Service; Marcel Roth, Puerto Rico Telephone Company; Homero Cordero, Radio Corporation of Puerto Rico; and Maurice Doran, 10th Naval District Headquarters.

The retiring president, James P. Fitzwilliam, was given a vote of thanks and appreciation for his leadership during the past year.

Scott-St. Louis

"Earth Satellite for Geophysical Studies" was the program feature of the May 3rd meeting. Presented by the Bendix Radio Division, Bendix Aviation Corporation, Baltimore, the program consisted of a lecture by Ernest A. Duquet of Bendix which was supplemented by slides and was followed by a question and answer period. The program was introduced by Joseph Moncrief, Public Relations, Bendix.

Special guests of the chapter were: Brig. Gen. Bert E. Johnson, Staff Judge Advocate, Headquarters Air Training Command, and Col. William D. Cairnes, Deputy Base Commander, Scott Air Force Base.

The new officers and directors elected at the April meeting were introduced, with Col. Charles W. Gordon, the new president, presiding.

Committee chairmen recently appointed were introduced as follows: membership—Lt. Col. Arvid E. Dahlberg and Edward H. Gray; meetings and programs—Allan L. Eisenmayer; publicity—Howard D. Yund; industrial relations—Clifford G. Wassall; financial—Earl F. Hagen; hospitality—Walter W. VanSkiver.

South Carolina

Mr. J. S. Bonner, General Coordinator of Civil Defense Services of the Southern Bell Telephone and Telegraph Company in Atlanta, was guest speaker at the May 3rd dinner-meeting held at the Columbia Hotel in Columbia. In an illustrated lecture on latest developments in Civil Defense, Mr. Bonner described the new alerting setup of the Air Force and the Civil Defense System which was placed in effect throughout the United States on May 1, 1957.

New chapter officers were elected during the business meeting as follows:

President — Cdr. Harry C. Rodin, Electronics Superintendent, Charleston Naval Shipyard, and Electronics Assistant to Industrial Manager, Sixth Naval District; vice presidents — W. Thomas Edwards, South Carolina Chief Engineer, Southern Bell Telephone and Telegraph Co.; Col. Hubert N. Sturdivant, Commanding Officer, 8th Communications Group, Shaw Air Force Base; secretary-treasurer—F. Lawrence

San Francisco—A tour of the trans-Pacific radio transmitting station of Mackay Radio and Telegraph Company at Palo Alto featured the May 16th meeting. Above, Sidney N. Barton, (second from right) chapter president and manager of the Mackay Radio station, explains oscilloscope pattern to a group of members.

Davis, South Carolina Inventory & Costs Engineer, Southern Bell Telephone and Telegraph Co.

Board of Directors: Hugh C. Pulliam, Vice President, South Carolina Continental Telephone Co.; Capt. Arlington C. Krajnik, 727th AC&W Squadron, Myrtle Beach Air Force Base; Cdr. Albert B. Kunz, Reserve Electronics Officer, Sixth Naval District.

South Texas

For the June meeting, Eberle Park, the picnic area for Randolph Air Force Base was the scene of a special get-together and a barbecued chicken dinner.

During the social hour preceding dinner, the young people of the Randolph Riding Club put on a jumping exhibition in the riding ring adjacent to the picnic area. Following dinner, the catering for which was done by the chapter treasurer and his wife, Capt. and Mrs. Blaine Shockey, two color sound movies were shown depicting the VOLSCAN semi-automatic and the ILS fully automatic instrument landing systems.

This experimental picnic meeting was such a decided success that the chapter plans to feature a similar gathering annually.

Southern Connecticut

The program of the May 16th dinner-meeting consisted of two films furnished by the Southern New England Telephone Company. One, entitled "Voices Beneath the Sea," told the story of the laying of the Trans-Atlantic telephone cable, and the other depicted the establishment of stations in the DEW Line.

Special guest of the chapter was Henry R. Bang, AFCEA Regional Vice President, who addressed the group on regional and national affairs of the Association.

Tinker-Oklahoma City

"NAVAIDS for the Jet Age" was the subject of the April 26th dinner meeting. The program was presented by John C. Mercer, Technical Assistant to

Scott-St. Louis—Seated, left to right: Ernest A. Duquet of Bendix Radio, principal speaker at the May 3rd meeting; Col. Charles W. Gordon, chapter president; Joseph Moncrief of Bendix Radio; and Brig. Gen. Bert E. Johnson, ATC, Scott AFB. Standing, left to right: Col. William D. Cairnes, Deputy Base Cmdr., Scott AFB; Robert E. Melling, chapter director; B. Roger Robards, vice-president; Allan L. Eisenmayer, secretary, and Prosper L. Kinsella, treasurer.

CHAPTER NEWS

Director of Materiel, 1800th AACS Wing, Tinker Air Force Base, who reviewed the problems of high speed aircraft and navigation in face of increased air traffic. He supplemented his remarks with color slides and a film on TACAN.

At the May 31st meeting, Delbert F. Cravens of Southwestern Bell Telephone Company was elected chapter president. Other new officers were chosen as follows: vice presidents—Robert E. Davis, 1881st AACS I&M Sqdn.; John C. Mercer; Col. William L. Gregory, 1800 AACS Wing; Jack W. Grewell, CAA; secretary—Lt. Col. Albert A. Rudd, 1800 AACS Wing; treasurer—Maurice Williams, Southwestern Bell Telephone Co.

Board of Directors: Lt. Col. Richard Amann, 1881st AACS I&M Wing; Orin Cline, Gilfillan Bros.; Fred W. Coble, RCA Service Co., Inc.; Loyd G. Dorsett, Dorsett Laboratories, Inc., retiring chapter president; Hal Doolittle, Southwestern Bell Telephone Co.; W. A. Kitchen, Oklahoma Gas & Electric Co.; Grant Landon, Oklahoma City Fire Department; M/Sgt. B. F. Niederkorn, 1800 AACS Wing; Frank Rohrer, Western Union.

The program for this meeting was arranged and conducted by Lt. Col. Richard Amann, Deputy Commander of the 1881st AACS Engineering and Installation Group. He gave a stereophonic sound demonstration which included audio, high fidelity, and tape recording and reproducing.

Washington

The 97th anniversary of the founding of the Army Signal Corps was commemorated at the chapter's June 11th luncheon-meeting at the Willard Hotel. Among the 410 members and guests in attendance were General of the Army Omar N. Bradley, former Chairman of the Joint Chiefs of Staff; a number of former Chief Signal Officers of the Army; and AFCEA's new National President, Rear Adm. Frederick R. Furth, USN (Ret.).

Highlight of the program staged by the Signal Corps and introduced by Maj. Gen. James D. O'Connell, Chief Signal Officer, was the "appearance" of Brig. Gen. Albert J. Myer, who organized the Signal Corps and served as the first Chief Signal Officer from 1860-1863 and from 1866-1880. General Myer, most ably impersonated by Col. Leon J. Fishkin, Office of Technical Liaison, OCSigO, congratulated his Corps on its accomplishments but also cautioned it against complacency and over-confidence. "After all", he said to General O'Connell, "you have just gotten around to getting rid of your pigeons!"

Washington—The Present meets the Past. Maj. Gen. James D. O'Connell, Chief Signal Officer, greets Brig. Gen. Albert J. Myer, the first Chief Signal Officer of the Army (impersonated by Col. Leon J. Fishkin), who appeared at the chapter's June 11th celebration of the 97th anniversary of the founding of the Signal Corps.

As was to be expected, General Myer reminisced on some of his experiences in organizing the Signal Corps during the Civil War but he went on to show a surprising knowledge of modern technology, thus proving that the Signal Corps gets the message through not only in this world but in the next.

General Myer paid tribute to several former Chief Signal Officers present. He presented a "one-time Albert J. Myer Award" to Maj. Gen. George I. Back, for "having done more than any other Chief Signal Officer in history to accumulate statistical information on the value of the ACAN system". He also paid tribute to Maj. Gen. Harry C. Ingles for having done the spade work in organizing the AFCEA, commenting "I wish I had had such an association as this to back me up in 1860". He cited Maj. Gen. Spencer B. Akin's service as General MacArthur's Signal Officer in the Pacific as "a wonderful example of the type of cooperation which should exist between a Commander and his Chief Signal Officer". He also said, "the closest the Signal Corps had ever come to being a joint command was when Akin had his own Navy and Air Force while he was MacArthur's Signal Officer".

Also featured in the entertainment was the Second U. S. Army Chorus from Fort George G. Meade.

During the business session, Chapter President M. C. Richmond formally presented the new officers and directors of the chapter for 1957-58 as follows: president - L. Harriss Robinson; vice-presidents - Maj. Gen. W. P. Corderman, USA; Col. B. M. Wootton, USAF; Capt. J. S. Dorsey, USN; and Harry M. Stephey; secretary - Ralph A. Irwin; treasurer - John R. O'Brien; general counsel - F. O. Willenbucher; board of directors - Percy G. Black; Claude B. Blair; John N. Boland; Capt. Will I. Bull, USN; Brig. Gen. A. F. Cassevant, USA; Ralph I. Cole; Francis Colt deWolf; Francis H. Engel; Paul Goldsborough; Maj. Gen. D. D. Hale, USAF; Thomas B. Jacocks; Keith B. Lewis; Col. I. F. Stinson, USAF; Capt. W. E. Sweeney, USN; and Rear Adm. J. N. Wenger, USN.

Following the installation, the chapter gave an enthusiastic vote of appreciation to President Richmond and George Sheets, out-going secretary, for outstanding direction and execution of Washington Chapter affairs during the past year.

Admiral Furth gave a short greeting to the chapter and congratulated it on its record of activities.

Seated at the head table were: General of the Army Bradley; General O'Connell; Admiral Furth; Maj. Gen. H. C. Ingles, former CSO 1943-47; Maj. Gen. S. B. Akin, former CSO 1947-51; Maj. Gen. G. I. Back, former CSO, 1951-55; Brig. Gen. J. H. LaBrum, USA (Ret.); Rear Adm. H. C. Bruton, Director of Naval Communications; Maj. Gen. A. L. Pachynski, Director of Communications - Electronics, USAF; Rear Adm. J. N. Wenger, Director of Communications-Electronics, JCS; Brig. Gen. A. F. Cassevant, Chief, Procurement Div., Dep-Log; Maj. Gen. W. P. Corderman, Deputy Chief Signal Officer; Maj. Gen. V. A. Conrad, Commanding General, Fort Monmouth; Brig. Gen. J. Dreyfus, Chief, Procurement & Distribution Div., OCSigO; Brig. Gen. W. P. Pence, retiring Chief, Combat Development & Operations Div., OCSigO; Brig. Gen. K. F. Zitzman, Chief, Combat Development and Operations Div., OCSigO; Capt. G. L. Caswell, retiring Asst. Director of Naval Communications; Capt. J. S. Dorsey, new Asst. Director of Naval Communications; outgoing President Richmond, Secretary George Sheets; L. Harriss Robinson, new president; Ralph Irwin, new secretary; and John O'Brien, new treasurer.

ITEMS OF INTEREST

From Government, Industry and the Services

New Defense Weapon

The Department of the Army has revealed the successful development of a versatile air missile system designed to reinforce the low-altitude capability of U. S. defenses.

Able to destroy the lowest flying aircraft, this new defense weapon, known as the HAWK, will carry a lethal, modern war-head. The missile can detect, track and attack craft in the blind zone of conventional radars and at ranges insuring effective protection of defended areas. It will complement the defense against high-altitude air attack provided by the Army's NIKE.

Flexible and mobile, the HAWK can operate in the continental United States air defense complex at fixed installations or with fast moving combat troops of the field Army. In its mobile role the HAWK also will be adopted by the U. S. Marine Corps.

Site selections for the new weapons already have been initiated in the New York City and Washington-Baltimore areas.

The HAWK, which uses a solid-fuel propellant, is about 16 feet long, 14 inches in diameter and utilizes radars of unique and highly effective design.

It was developed and will be produced by Raytheon Manufacturing Company, prime contractor for the entire system. (See Cover)

"Gapless" Coverage For MATS

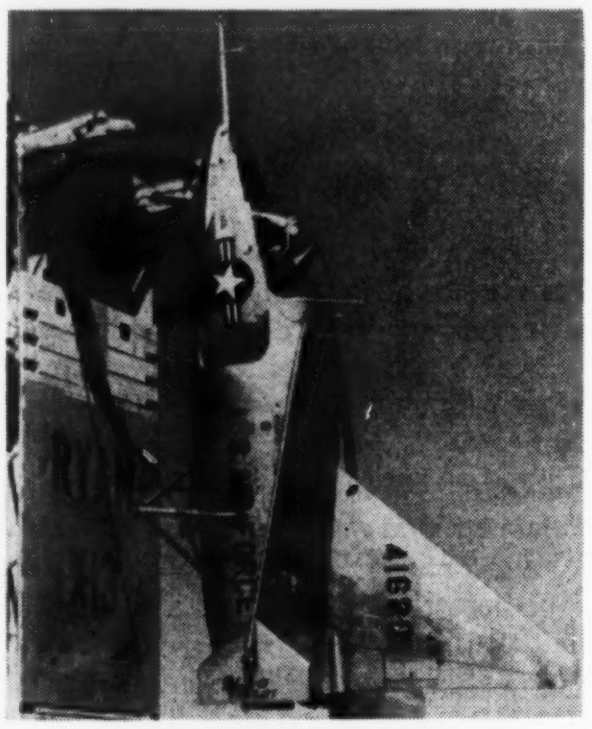
A new air-to-ground communications system has been designed to provide "gapless" coverage for Military Air Transport Service planes approaching and leaving East coast air fields. A combination of telephone land lines and UHF radio, the development was announced by MATS and the Long Lines Department of American Telephone and Telegraph Company.

The system permits contact with aircraft about 400 miles from control centers at McGuire, N. J., and Dover, Del., Air Force Bases. As a plane flying the North Atlantic route approaches the East coast, its radio signals are automatically picked up by the nearest receiver and relayed by wire to McGuire and Dover.

With previously used systems the approaching plane had to be within range of the base to communicate directly.

Automatic speech level regulation and improved tonal quality are characteristics of the system.

Effective range of the radio equipment will be increased 20 per cent by use of high-gain antennas.



The Air Force's Ryan X-13 Vertijet, pictured here, is capable of taking off in a vertical attitude and quickly switching to high speed horizontal flight.

The Ryan X-13 Vertijet

The U. S. Air Force Ryan X-13, world's first Vertijet (vertical take-off and landing jet airplane, VTOL) has demonstrated successfully its ability to take off straight up, make the transition to high speed horizontal flight, then back to vertical hovering for a zero speed landing, it has been officially disclosed.

Under the hush of military security, the VTOL research craft, first of an entirely new class of high-performance jets, has been flying for more than a year at the Air Force Flight Test Center. First flight was December 10, 1955, piloted by Peter F. Girard, chief engineering test pilot for Ryan Aeronautical Company, San Diego, designers and builders of the X-13. First complete VTOL flight in full operational sequence was made by Girard on April 11, 1957.

Rising and descending on a column of seething exhaust gases, the Vertijet depends solely upon thrust from its jet engine for both direct lift and high speed conventional flight.

A Computer Composer

Mathematicians Dr. Martin Klien and Dr. Douglas Bolitho have proven to their satisfaction that an electronic digital computer is capable of writing popular music.

Reasoning that if humans could write poor quality popular music at the rate of a song an hour, they could compose music of an equal caliber faster with a machine.

In less than a month they educated the Datatron Digital Computer to write songs at the rate of more than 4,000 an hour. Composer and ASCAP member, Jack Owens, set lyrics to one of the melodies, five recordings were made and the tune, "Push Button Bertha," was introduced on the ABC network.

However, the Library of Congress refuses to issue a copyright since they have never been confronted with a machine written piece of music.

New Insurance Plan For Servicemen

A $10,000 group life insurance program, designed to provide service men and women with the maximum amount of family protection at low cost, is being offered to members of the Armed Forces Enlisted Personnel Benefit Association, it was announced recently by the Board of Directors, representing all of the Services.

Available to all grades of "regular" enlisted personnel of all Services, the group life insurance plan is designed solely to assist the serviceman on active duty. No medical examinations will be required.

Supplementing the benefits offered by the Survivors Benefit Act where necessary, the plan formerly was available only to commissioned and warrant officers.

Regardless of age or travel requirements, the monthly contribution will be $9.00 for all members, except those performing hazardous duties. Such members will contribute $12.50.

Master Sergeant John J. Klasinski, Army representative on the Board of Directors, said it is anticipated that annual refunds will be made to reduce the cost of the plan to members.

The program will be underwritten by Mutual of New York and upon

ITEMS OF INTEREST

Association membership termination, the insured can convert the life insurance, without medical examination (within a specified period of time) to any permanent form of insurance customarily issued by this company.

Facsimile Set Speeds Battle Pictures

The Army has produced a new, portable, high-speed radio facsimile system capable, in five minutes, of rushing a high quality photo to a destination miles away. This is said to be the fastest way to convey a photo from one spot to another.

Developed by the U. S. Army Signal Engineering Laboratories, Fort Monmonth, N. J., the device can flash vital military reconnaissance pictures by radio to command headquarters in time to affect critical decisions.

The new system fits easily into the back of a radio-equipped jeep or car and can send a picture to its companion receiver 40 miles away. A photo can also be dispatched thousands of miles over standard telephone lines as well as around the world by long range circuits.

Mounted on a light reconnaissance plane or helicopter, the set is able to speed aerial surveillance pictures directly to battle headquarters from the aircraft.

In addition to combat application, the facsimile can speed military weather predictions and prove valuable to newspaper photo reporting.

Combining high-speed Army techniques with Polaroid film, the system, the fastest of its kind in the world, produces a finished print in one minute without use of a darkroom.

Denison Research Foundation Organized

In view of today's more or less universal interest in the subject of research and development, coupled with the shortage of available engineers, William C. Denison announces the organization of the Denison Research Foundation, a non-profit corporation.

Denison Research, located in Columbus, Ohio, will serve industry and the U. S. Government by providing talent and facilities for conducting a wide variety of research. Initial emphasis will be on projects in the electronic, mechanical, metallurgical, ceramic and management fields.

Tiny silicon wafers, or solar batteries, grouped in long narrow clusters on the crown of the Army's new helmet radio, can provide all the electrical power needed to operate the transmitter-receiver. Like the original helmet radio, the sun-powered version is a development of the U. S. Army Signal Engineering Laboratories, Fort Monmouth, New Jersey. Teamed with small nickel-cadmium storage batteries for peak power and nightime operation, the solar cells can provide current for as much as a year, as compared with dry cell life measured in hours.

Army Helmet Radio

According to the Department of the Army, exposure to sunlight may soon be all that's needed to obtain electrical power for year long operation of both transmitter and receiver of a helmet radio now under development.

The helmet-housed radio experiments proved so promising that similar power is now under consideration for the walkie-talkie and other light field radios.

These experiments, conducted at the U. S. Army Signal Engineering Laboratories, Fort Monmouth, N. J., have shown that solar batteries, which convert light to electricity, can power the world's smallest transmitter-receiver.

Long, narrow clusters of tiny solar cells are placed on either side of the crown of the helmet. Powering the radio for normal daylight operation, these silicon wafers also charge four small nickel-cadmium storage batteries to operate the set at night as well as supply peak current in daytime.

Use of the solar cells in combination with rechargeable nickel-cadmium batteries would provide power for many months, possibly a year or more. With dry cells now used in the helmet radio, battery life is less than a day if used continuously.

Radar-Equipped Blimp

Blimps, with a radar antenna rotating inside the airship's skin, will be the newest addition to the Nation's defense arm, the Continental Defense Command revealed recently. The radar-equipped blimps join the continuing ocean patrols.

Test flights of the blimps have been conducted since January, according to General Earl E. Partridge, commander in chief of the Air Defense Command. Beginning January 14, four of the "ZPG" blimps, built by Goodyear Aircraft Corporation, made a 10-day continuous sentry flight over the Atlantic. Weathering a 37-hour blizzard and long periods of "zero-zero" visibility, they set records for endurance.

"The airship," said General Partridge, "has established its position as the ideal electronics carrier suitable for operation and antisubmarine warfare as well as radar early warning."

New Guided Missile Developed by British

The British Navy has developed a ship-to-air guided missile, known as the "Seaslug," which is capable of engaging enemy bombers at any height where modern aircraft can operate.

Propelled by a motor and four rockets, the "Seaslug" will attack bombers which evade fighter defenses of the Fleet. Targets are detected by long range radar and subsequently plotted for range, height and bearing.

The missile is operated and fired from positions within the ship that do not necessitate crew exposure. Firing of the missiles requires a smaller crew than the conventional gun in a major warship. However, a large number of officers and men are engaged in maintenance and preparation for launching. The "Seaslug" is projected from a triple-ramp launcher automatically fed from a magazine below decks.

ITEMS OF INTEREST

Dynamics Corporations Acquire REL Stock

It has been announced recently that Dynamics Corporation of America has acquired all the outstanding stock of Radio Engineering Laboratories, Inc.

The company's growing communications operations, including Radio Engineering Laboratories, will be consolidated in a new 170,000 square foot building. This step will combine in one building the manufacturing of their ship-to-shore marine radiotelephones, television broadcasting, single side band communications and tropospheric scatter telephone equipment.

Fire Truck Combats Large Scale Fires

A highly mobile aluminum fire truck, designed for effective employment in combating large scale fires, and those involving non-conventional fuels, has been developed by the U. S. Army's Engineer Research and Development Laboratories, Fort Belvoir, Va.

Manufactured by the Walter Motor Co. of Long Island City, N. Y., the truck is equipped with a turret to combat large fires inaccessible by hose. It carries a 1,000-gallon water tank and 150 gallons of concentrated foam. A pump driven by the main engine provides for discharges of fire extinguishing foam at rates up to 6,000 gallons a minute.

All equipment is enclosed in insulated compartments heated by an automatic gasoline-fired electrically controlled coolant heater. The entire unit, built to operate in temperatures as low as 65 degrees below zero and as high as 125 degrees, is also capable of withstanding the harmful effects of salt water, high humidity, fungi, molds and tropical insects.

Army to Sponsor Symposium

The United States Army, in cooperation with all military services, Department of Commerce, and the National Security Industrial Association, will sponsor the Third Joint Military-Industry Packaging and Materials Handling Symposium on October 1, 2, and 3 at Fort Lee, Virginia, home of the U. S. Army Quartermaster Corps.

Top level defense and industrial leaders will address the symposium entitled, "Packaging and Materials Handling in Action." The symposium will relate packaging and materials handling to conditions in the field and will familiarize defense and industrial personnel with new developments in critical areas of mutual interest. Exhibits and field demonstrations will be featured.

Further information is obtained at the Procurement division, Deputy Chief of Staff for Logistics, Dept. of the Army, Washington 25, D. C.

Remote Vehicle Control

Lear, Inc., of Grand Rapids, Michigan, has introduced a unique system for remote control of vehicles. Equipped with the Lear system, a vehicle may be used for obtaining data or information from remote, hazardous, or otherwise inaccessible areas via a television transmitter. Easily installed in any tracked or wheeled vehicle, the system uses electromechanical actuators to control the functions usually performed by the driver. The vehicle may be controlled by radio or through an electrical cable which permits a variety of driver locations. Ordinary manual operation of the vehicle is not hampered, and quick switch-over from manual to remote control is easily accomplished.

The system was designed to operate under the most extreme environmental conditions and has been used in actual testing of U. S. Marine Corps land vehicles under dangerous surf conditions. In this application, the LVT was controlled by radio from a hovering helicopter or from an observation post on the beach.

(*Continued on page* 76)

PERSONNEL CLEARING HOUSE

AFCEA Members Available to Industry

The pages of SIGNAL are open to active AFCEA members who are seeking positions in the communications, electronics and photographic industries. Any member is entitled to space free of charge in this column for three issues of the magazine. Please limit your notice to five lines. In replying, employers are asked to address: Box ....., SIGNAL, 1624 Eye Street, N. W., Washington 6, D. C. Letters will be forwarded to the AFCEA member.

FIELD ENGINEER: ELECTRONIC, COMMUNICATION, MARINE EQUIP'T. Data processing and automation. DOD project coordination. Branch Management, sales promotion, customer relations. Surveys and reports, subcontract and material expediting, program planning, production control, priorities. Box 123.

REPRESENTATIVE, with all clients performing R & D or supply work for Wright Field and other agencies, needs more lines to develop with both military and commercial potential. Preferred are electronics or photographic equipments and ANP (have AEC Access) or packaging material. Box 124.

MANUFACTURERS REPRESENTATIVE, WASHINGTON, D. C. Long established and contacting all government procurement points in Washington, D. C., has opening for an additional account. Prefer a company manufacturing an end-use item and which is already doing some business with the military. Can also cover Philadelphia and Fort Monmouth. Replies confidential. Box 125.

MANUFACTURERS LIAISON REPRESENTATIVE. Retired Lt. Colonel, Communications-Electronics Officer with twenty-one years experience. · Education: Electrical Engineering and Business Administration. Familiar with Operational Suitability Testing and R & D. Desires to represent manufacturers or act as liaison for companies conducting business with Eglin Air Force Base, Florida. Box 126.

MANUFACTURERS REPRESENTATIVE with over sixteen years experience, partly as a USAF employee, in negotiating and liaison engineering of contracts with the USAF at Wright Field and Gentile AF Depot has time available for additional companies desiring or doing Air Force business. Box 127.

Government and Military Positions Available

Government and military agencies are invited to use this column to announce available positions which may be of interest to the readers of SIGNAL. Notices will be published three times if not cancelled before. Applicants apply as indicated in individual notices.

ELECTRONIC TECHNICIAN ($7,570-$8,645 plus 25% (non-taxable) cost of living allowance). Major duties are to plan, direct and supervise the operation and maintenance of carrier, repeater, terminals, telegraph and associated equipment installed in the toll test rooms. Includes inspections of facilities to determine required training, the organizing of the training and when necessary the actual conducting of the training. Three years general experience required and three years specialized experience. Inquiries should be directed to Civilian Personnel Officer, Alaska Communication System, 550 Federal Office Biulding, Seattle 4, Wash.

ELECTRONIC ENGINEERS GS-5 through GS-12. These positions have a salary range of $4,480 through $8,645 per annum. Employees in these positions serve as advisors and consultants to Signal Corps Contracting Officers on technical phases of procurement of Signal Corps equipment during the period of solicitation and during the life of the contract. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

SUPERVISORY GENERAL ENGINEER ($6,950 a year). To serve as an assistant to the military post engineer. Function of the Depot Facilities Division is related to maintenance, care and preservation of all buildings, structures, and rights-of-way and other real estate of the depot; responsible for fire protection and prevention for the depot, and management of depot facilities. Inquiries may be directed to the Civilian Personnel Office, Decatur Signal Depot, Decatur, Illinois.

EAST COAST PICTORIAL CENTER has an opening for a studio electrician at $2.51 an hour. Duties include operating most elec-

(*Continued on page* 76)

The Microwave Radio System *that Grows... as you Grow!*

RCA Microwave Radio Systems are designed with future needs in mind. They do not face obsolescence because of users' growth. High channel capacity permits orderly growth up to a total of 120 channels for voice, data transmission, supervisory control and other purposes.

RCA was one of the earliest pioneers in the development of microwave for commercial communications. Today, RCA Microwave Systems provide users throughout the world with many important features . . . operation in the most advantageous frequency bands, simplified installation and minimum maintenance cost.

Serving their users with dependability and precision, RCA Microwave Systems are now operated by utilities, gas and petroleum pipelines, cross country turnpikes, and government agencies.

More than a million channel miles of RCA Microwave Systems in service . . . performance proved throughout the world.

RCA Microwave specialists will be glad to answer any questions and help plan your installation. Mail coupon for further particulars.

RADIO CORPORATION of AMERICA
COMMUNICATIONS PRODUCTS
Camden, N.J.

SPECIAL NOTE TO RCA CUSTOMERS:

Ask about the RCA "Package Expansion Plan" which confirms your wise choice of RCA CW-20 or MM-26 Microwave for your communications system. A minor field modification will bring your system up to 48, 72 or even 96 channel capacity, depending on your revised requirements.

Radio Corporation of America
Communications Products
Dept. U-291, Building 15-1, Camden, N. J.

☐ Tell me more about RCA "Package Expansion Plan."
We have RCA_____Microwave.

☐ Send latest literature on RCA Microwave Radio for use in _____

NAME _____ TITLE _____
(PLEASE PRINT)

COMPANY _____

ADDRESS _____

CITY _____ ZONE ____ COUNTY _____ STATE _____

☐ Have representative contact me.

trical equipment, required for motion picture production. Knowledge of lighting effects and switchboard wiring required. A position is also available for an architectural draftsman at $4,525 a year. Situation requires ability to execute designs and plans for motion picture settings, and to paint and dress sets, dioramas and other pictorial representations. Clerical duties include filing, developing and printing of blue prints, and a minimum amount of typing. For further information, write to Civilian Personnel Office, Army Pictorial Center, Long Island City, 1, N. Y.

PHYSICIST—GS-9. Qualified expert on radiology responsible for the operation of the film badge service unit and for the monitoring of personnel, material, equipment and radioactive sources. Accountant—GS-9. Responsible for receiving and analyzing all reports generated by the Finance and Accounting Branch; practical application of accounting theories. Cost Accountant—GS-9. Serves as Staff Accountant for the Maintenance Division responsible for performing professional accounting work in connection with cost accounting and Army Industrial Fund activities. Electronic Engineer—GS-7. Responsible for independent accomplishment of professional engineering work as related to research, development, design, evaluation, standardization, modification, etc., of prototype production and fabrication models of electronic equipment. Inquiries should be directed to the Civilian Personnel Director, Lexington Signal Depot, Lexington, Kentucky.

MEDICAL OFFICER GS-12. This position pays $8,645 per annum. The employee will be responsible for the operation of a Federal Civilian Health Service type of dispensary containing examination and treatment rooms and equipment. Examines military personnel having initial responsibility for diagnosis and disposition of cases for treatment. Submit resume and the Armed Forces Communications and Electronics Association will forward same immediately to employer who will acknowledge your application direct.

FORT MONMOUTH VACANCIES

Supv. Physicist (General), GS-14; Electronic Engineer (General), GS-14.

Duty Station: Pasadena, California.

Electronic Engineer (Radio), GS-13.

Duty Station: Christ Church, Hampshire, England.

Electronic Engineer (General), GS-13; *Duty Station:* Fort Monroe, Va., Fort Knox, Ky., Fort Bliss, Texas, and Fort Rucker, Ala. Electronic Engineer (Radio, Instrumentation), GS-12; Chemical Engineer, GS-11; Electronic Engineer (Radio, General & Wire Communications), GS-11; Mechanical Engineer (S&S, Signal Equipment), GS-11; Training Officer (General Fields), GS-11; Mechanical Engineer and Mechanical Engineer (Signal Equipment), GS-9; Employee Utilization Representative, GS-9; Instructor (Radar, Radio-Microwave, Wire Sound Recording), GS-9; Radio & Electronic Equipment Installer and Repairer, WB-15.

U.S. CIVIL SERVICE COMMISSION. Vacancies now exist for Electronic Technician positions in the Civil Aeronautics Administration in Alaska. Starting salaries are $4,080 and $4,525. No written test required. Full information on how to apply may be obtained at many post offices throughout the country or from the U.S. Civil Service Commission, Washington 25, D. C.

U.S. CIVIL SERVICE COMMISSION has announced vacancies for communications cryptographic coding clerks at $3,415 a year. Applicants must have general experience as a clerk, typist, teletypist or telegrapher, plus 6 months of specialized experience in enciphering and deciphering messages, involving the use of a variety of current cryptographic systems and devices. Radio broadcast technician positions are also available in the International Broadcasting Service at $5,915 a year. No written tests required. Further information and application forms from the U.S. Civil Service Commission, Washington 25, D. C.

ELECTRONIC ENGINEERS. Starting salaries $5,335 and $6,115. Electronic Technicians, salaries from $3,670 to $5,440. Vacancies now exist at the Electronics Division of the New York Naval Shipyard, located at Navy and Sands Streets, Brooklyn 1, N. Y. The shipyard is engaged in activities ashore and afloat, including construction of new super-carriers. Direct inquiries to the Industrial Relations Officer, Telephone Main 5-4500, Extension 2877, 2379 or 2593.

FORT HUACHUCA VACANCIES

Supervisory Electronic Engineers (2) GS-855-14, General
Electronic Engineers (2) GS-855-13, General
Electronic Engineer GS-855-13, Instrumentation
Electronic Engineer GS-855-13, Radio
Electronic Engineer GS-855-12, General
Electronic Engineers (2) GS-855-11, General and Radio
Electronic Specialist GS-855-9
Electronic Engineer GS-855-9
Physicist GS-855-9
Supervisory Analytical Statistician GS-1530-12
Mathematician GS-1520-12

SCENARIO WRITER ($7570 per year). Six years of progressively responsible and successful experience in writing scenarios, script, dialogue for motion pictures or related fields. Experience must include three years in field of motion pictures. Substitution of education for experience: successful completion of study in college or university may be substituted for not more than 3 years of the required experience on the basis of one year of education for each 9 months of experience. No educational substitution will be allowed for experience in the field of motion pictures. Grade GS-1071-12. Army Pictorial Center, Long Island City 1, N. Y.

TELETYPE OPERATORS, COASTAL STATION RADIO OPERATORS. International communications company. Liberal company benefits. Submit resume with name, address, age, past experience—if any, military experience—if any, FCC Second Class Radiotelegraph license required for Coastal Station Radio Operator. Write to Asst. Director of Personnel, RCA Communications, Inc., 66 Broad Street, New York 4, N. Y.

ITEMS OF INTEREST

New RCA Appointments

The Radio Corporation of America recently announced two executive changes. Theodore A. Smith was appointed executive vice president, Industrial Electronic Products, and Orrin E. Dunlap, Jr., vice president, Institutional Advertising and Publications.

In his new capacity, Mr. Smith will be responsible for RCA's computer, telecommunications, industrial control systems and other commercial products.

Mr. Dunlap will be in charge of the institutional advertising program and all publications of an institutional nature.

Texas Instruments Appoints New Engineer

Louis G. Karagianis has been named Military Relations Engineer for the Semiconductor-Components division of Texas Instruments Incorporated. His appointment, along with his assignment to a new office opened at Dayton, Ohio, was announced by Earl Trantham, S-C division Military Relations Manager.

In Memoriam

The founder of the International Telephone & Telegraph Corporation, Sosthenes Behn, died of a heart attack in New York on June 6. He was 75.

Mr. Behn, who, with his brother, organized the world-wide communications corporation in 1920, held the position of president until 1929 and retired as chairman last year.

Born in St. Thomas, V. I., he moved to Puerto Rico in 1906 where he later attained control of the telephone system. This became the basis of I. T. & T. which was operating in 42 countries by 1933. After connecting Puerto Rico with the United States by a series of land and submarine cables, he expanded his enterprises to Europe in 1924.

To carry out the proposed rehabilitation of the Spanish national telephone network, Mr. Behn raised $30 million from J. P. Morgan & Co. to buy the International Western Electric Co. This addition to I. T. & T. provided manufacturing subsidiaries and associates in Europe, Asia, and South America.

A major change in educational policy

CREI announces direct personal supervision for home-study final exams

Occasionally you will find skeptics who question the authorship of answers given in home study examinations. Possibly you have questioned this yourself. Did the student receive help? How can you be sure the home study course graduate actually knows what his diploma indicates he *should* know?

Our experience over the years indicates improperly-aided examinations to be an unlikely occurrence. CREI examination procedure has always been rigorous. However, to protect *all* our graduates from the effects of the above-mentioned skepticism . . .

CREI has instituted a new testing procedure which will add even more meaning to the CREI Diploma . . . in the eyes of both industry and education.

Effective immediately, all CREI final examinations will be given under personal and authoritative supervision. Here is how the new plan works:

1 CREI sends final examination papers in 4 sealed envelopes to a designated supervisor in the student's own city. The supervisor will be a university or college department head . . . a high school principal . . . or (in the military services) he will be a commissioned officer attached to the student's ship or station (preferably the educational officer). In industry, the supervisor may be a responsible engineer who is superior in rank to the student.

2 At the time the examination papers are sent, the student is notified where the examination may be taken. He then contacts his selected supervisor and arranges a mutually agreeable time for the 4-section examination, which requires full mornings and afternoons of two days.

3 The student is given one section at a time, which he completes under the supervisor's administration. (The exams are primarily mathematical, and consist mainly of practical problems designed to test the student's knowledge of various sections of the course.)

4 The supervisor returns the examination and the answers to CREI for grading, with a certification that the test was taken in privacy, and that there was no help received from anyone.

This forward step in educational technique is typical of CREI leadership through the years. For detailed information about any phase of CREI's Home Study or Residence Program, and how it can help with your technical manpower or training program, please write directly to E. H. Rietzke, President.

CAPITOL RADIO ENGINEERING INSTITUTE

ECPD Accredited Technical Institute Curricula • Founded in 1927

Dept. 217-D, 3224 Sixteenth Street, N.W. - Washington 10, D.C.

NEW PRODUCTS FROM INDUSTRY

Smallest Teleprinter In History

Called the "Mite," a miniaturized, 12-pound page teleprinter has been developed by the Western Union Telegraph Co., 60 Hudson St., New York 13, N. Y.

Smaller than a portable typewriter, the unique teleprinter measures only 5 x 11 x 11 inches. It will operate at any standard speed up to 100 words a minute, and in any position—horizontal, vertical, or otherwise.

Designed on a compact, building-block basis, the miniaturized unit is expected to be far less costly to manufacture than standard machines.

Liquid-To-Air Cooling Units

For airborne, shipboard, or ground support electronic equipment, The Hallicrafters Co., 4401 W. Fifth Ave., Chicago 24, Ill., is now producing 3 newly-perfected cooling units claimed to be the first liquid-to-air cooling units offered to the electronic industry in ratings over 2,000 watts.

Revolutionary in design and capable of dissipating up to 7,000 watts, these units are 20% less costly and 30% lighter and more compact than comparable units now in use. In addition, they meet environmental conditions of MIL-E-5272 and MIL-E-5400 specifications, permit use of standard racks, and accommodate whatever auxiliary gear is desired.

All 3 stock units now available will dissipate 2,000-5,000 or 7,000 watts and can be adapted to any intermediate rating required.

First All-Transistorized Miniaturized Telephone Carrier System

Now available for military use is the new completely transistorized, miniaturized "tactical telephone terminal" recently developed by Lenkurt Electric Co. of San Carlos, Calif.

The new multiple-channel telephone carrier system provides 4 voice channels and an order wire for either radio or cable transmission. Four terminals can be stacked together to provide a 16-channel system. The first all-transistor system of its kind to use the frequency-division method in providing extra voice channels, it requires less than half the power needed by the AN/TCC-3 terminal used by Signal Corps since 1952.

Designed for mounting in military vehicles, this new compact terminal takes only 3½" of vertical space in a standard 19" telephone rack, and is about 1/7 the size of equipment now in use. Weighing only ⅓ of the 170-pound AN/TCC-3 system, it is easily handled by one man.

Constructed to meet military environmental and strength requirements, a unique "egg-crate" type of chassis construction is used, and unitized plug-in subassemblies are hermetically sealed.

Built-in facilities for 3750-cps out-of-band AM signaling permit E and M signaling. A separate signal option unit provides 4 more types of signaling.

Telemation

TelePrompTer Corp. of 311 W. 43rd St., New York, N. Y., now offers a series of new devices which may be operated in conjunction with their new process called "telemation," said to provide high efficiency both in TV and at meetings of any size or description.

Telemation copes electronically with the problems of synchronizing a speaker's words with off-stage effects by effectively providing fluff-proof insurance. Wiring of the teleprompter allows telemation to function similarly to an alarm clock which turns on a radio or furnace. As a cue word is spoken, an aluminum strip reaches a contact and an electronic circuit to the telemation unit is triggered. Whatever it may be—operation of a movie projector, slide projector, spot light or recorded music—the desired effect is activated instantly with no possibility for error or mistiming.

Among the 18 new accessory devices is the "magic hand." This wireless control, which starts and stops the 'prompter and governs the speed of the 'prompter script, enables the controlling operator to work from anv location in the studio without cable encumbrance.

Another is the new automatic projector equipped with a slide-changer that will feed 60 slides in 60 seconds. Capable of producing 6,000 lumens of light, it is said the projector offers excellent definition and light value in addition to its portability (955 lbs.), high efficiency, remote-control and automatic slide-changing features.

Radar System Employs Unique Indicator

Sperry Gyroscope Co. of Great Neck, N. Y., now features in its APN-59 radar system a pilot's auxiliary indicator, unique in its field, which uses a 5-inch cathode ray tube with excellent definition for viewing of targets located at distances up to 240 miles.

Mounted in the cockpit of an AF C-97, the pilot's auxiliary indicator can be held on a relative bearing type of presentation while the navigator's indicator is oriented to magnetic North or any other preselected compass setting.

Said to provide greater versatility, reliability, compact packaging and very high resolution in range and bearing, the APN-59 is the smallest and lightest radar for its power and range and is used in troop-carrying and cargo aircraft for search, surveillance, storm detection and other all-weather navigational purposes.

New Bell Radio Relay System

A new microwave radio relay system, capable of carrying 3 times as many telephone calls, radio programs and TV shows as the most advanced network currently operating in the U. S., has been developed by Bell Telephone Labs., 463 West St., New York 14, N. Y.

Capable of carrying more than 10,000 telephone conversations, or a combination of 12 TV programs together with more than 2,500 phone calls, the new system also provides increased capacity for transmitting the "digital" information used in teletypewriter and data transmission. Featuring extremely fast switching equipment, the system is capable of bringing in alternate equipment or channels in case of component failures or atmospheric disturbances.

5-Watt, 10-Megacycle Transistor

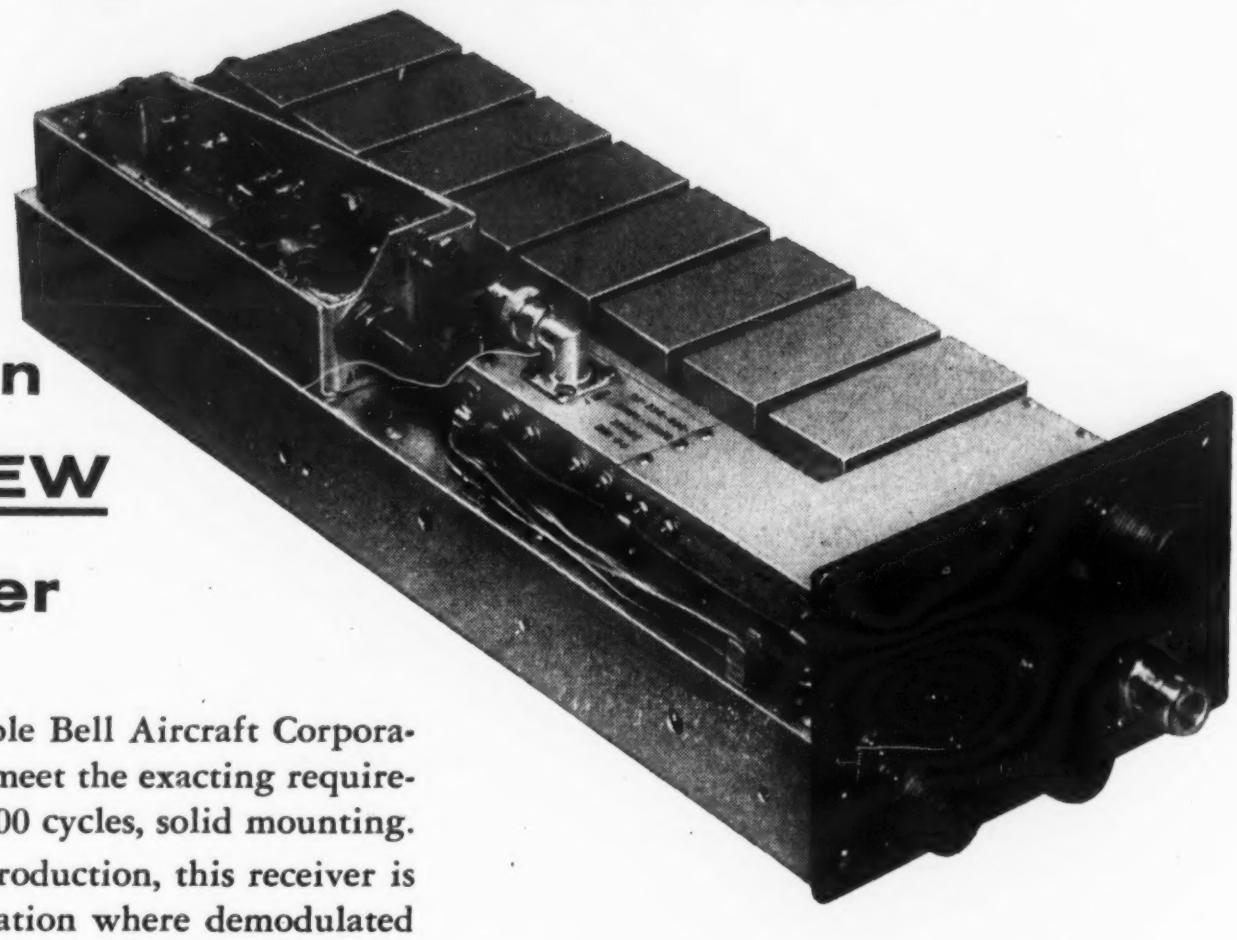
An experimental silicon power transistor, capable of providing an output of 5 watts at 10 megacycles either as an oscillator or an amplifier, has been developed at Bell Telephone Labs., 463 West St., New York 14, N. Y.

Unilateral gain is in excess of 20

(*Continued on page* 80)

15g's
15g's
15g's

15g's VIBRATION



. . . no problem in Bell Aircraft's NEW 400 mc Receiver

Modular packaging techniques enable Bell Aircraft Corporation's new 400 megacycle receiver to meet the exacting requirement of 15 g's vibration from 5 to 2000 cycles, solid mounting.

Now thoroughly proven and in production, this receiver is available immediately for any application where demodulated control signals are needed for the activation of command systems requiring a high signal-to-noise ratio, high sensitivity and stability, and a wide audio bandwidth with low harmonic and phase distortion. It is equally at home in guided missiles — as a range safety instrument — or as a ground monitor receiver.

The new 400 mc receiver is only one of many examples of the ability of Bell Aircraft's new *Avionics Division* to design, develop and produce avionic systems, units and components for any needs, however complex. If you have design or production problems in this field, write, wire or phone: Sales Manager, Avionics Division, BELL AIRCRAFT CORP., Post Office Box One, Buffalo 5, New York.

ELECTRICAL SPECIFICATIONS

TYPE: FM 300 KC Deviation
TUNING RANGE: 406 to 420 megacycles
Plug-in assemblies to extend range to 500 mcs available
OSCILLATOR: Crystal controlled
SENSITIVITY: 5 microvolts or better for 10 db quieting
INPUT IMPEDANCE: 50 ohms
BANDWIDTH: 1.15 mcs ± .1 at 3 db
IMAGE AND SPURIOUS RESPONSE: Better than 60 db
OUTPUT: ± 0.5 db 40 cps to 40 kc 3 db at 100 kc
3.5 volts RMS 500 ohms closed circuit
SQUELCH: Adjustable squelch relay from 10 to 100 microvolts input
POWER INPUT: Less than 50 watts. Power supplies available for 115V - 400 cps or 28VDC

MECHANICAL SPECIFICATIONS

DIMENSION: 3.6 x 5.5 x 15.25 inches.
VOLUME: 300 cubic inches
WEIGHT: 10 pounds
MOUNTING: Solid — 9 mounting screws
OPERATING ENVIRONMENTS: 15 g's
5 to 2000 cycles -55° to +72°C

THIS NEW BOOK telling of many new and unusual developments in the field of Avionics is yours for the asking. Send request on your letterhead to: Sales Manager, Avionics Division, BELL AIRCRAFT CORP., Post Office Box One, Buffalo 5, N. Y.

BELL Aircraft CORP
Avionics Division
BUFFALO, N. Y.

NEW PRODUCTS

db, and collector efficiency of better than 40% has been achieved. This unit is a p-n-i-p diffused emitter and base transistor, in which a near-intrinsic or "neutral" layer of silicon separates the collector from the other elements.

Alpha cutoff is about 100 megacycles per second, and when used as an oscillator, laboratory samples have produced as much as one watt output at 100 megacycles per second. Input and output impendances are on the order of 20 ohms and 300 ohms, respectively.

Further improvement in the diffusion process, packaging, and other features is expected to result in a transistor which is highly reliable and relatively easy to manufacture.

Unique Air Rescue Facility

Given the problem of developing a lightweight control center which could be towed in a trailer or packaged in a helicopter for transport to the nearest possible site of a disaster scene, Instruments for Industry, Inc., of 150 Glen Cove Rd., Mineola, N. Y., has developed a new type of lightweight radio control center uniquely meeting such demands.

The complete AN-GRC-47 assembly is mounted on a 2-wheel trailer and the radio equipment inside the shelter is encased in watertight, shock-resistant carrying cases specially developed for this application.

Sitting within this control center, an operator can make contact with other aircraft in the vicinity, with ground teams, or any other mobile communications group cooperating in the rescue program.

In addition to facilities for both heating and air conditioning provided in the well-insulated shelter, this Air Rescue Facility offers two unique features: the entire shelter can be folded up like an accordion into a package and only two men are needed to transport, set up and put the center into operation within 15 minutes after the operating site has been reached.

Completely Transistorized "Multiverter"

The first commercially-available, completely transistorized analog-to-digital and digital-to-analog converter has been announced by Packard-Bell Computer Corp., 11766 W. Pico Blvd., Los Angeles 64, Calif.

Called the "Multiverter," the unit provides for high-speed conversions

of voltage to digital and digital to voltage at accuracies of better than .01 per cent. Speeds in excess of 15,000 per second are achieved in analog to digital conversion and 300,000 per second for digital to analog conversion.

Claimed to be the most accurate converter ever produced, the Multiverter is the first all-electronic device which permits multiplication and division in the process of conversion. Moreover, when supplied either as an incremental or as a whole number converter, this unit can interchange speed and accuracy so as to follow high frequency signals at reduced accuracies.

New Literature

Chart For Reference Data On Capacitors

A convenient chart for providing excellent reference data on capacitors in a quickly-available form may be obtained free of charge from the Electronics Division, Erie Resistor Corp., Erie, Penna.

Measuring 7⅝" x 4⅛", the plastic card shows dielectric qualities and temperature coefficients of Erie tubular and disc-ceramicons as well as maximum available nominal capacities in MMF. On the reverse side, dimensions of Erie ceramicons and PACs are given.

Muirhead Magslips

Publication "E-1000, Muirhead Magslips, Applications and Methods of Use," a unique 60-page volume offering the would-be designer complete information on Muirhead Magslips and Synchros, is now available from Muirhead & Co. Limited, Beckenham, Kent, England.

Illustrated throughout by photographs, graphs and circuit diagrams, the work opens with a brief note on the history of remote indicating devices, sketches the development of the Magslip and then elucidates the theory of operation.

A simple explanatory first chapter is included for the guidance of those having only a slight acquaintance with the subject. Later chapters deal more fully with technical data concerning design, operation, and application of Magslips and Synchros.

Covering varied aspects of usage, such as remote control and remote indication, design and layout of new applications, and tests and fault location, the book concludes with a comprehensive subject index.

The Coming Electronic Communications Revolution

Forecasting the radical advance of electronic communications and its revolutionary impact upon the total marketing process for every phase of American industry in a staggering short period of 10 years, E. B. Weiss' study-in-depth is now available at no charge from Doyle Dane Bernback, Inc., 20 W. 43rd St., New York 36, N. Y.

Building upon the fact that faster communications means faster marketing, this 63-page booklet explores the exciting consequences for marketing to come with the development of fascinating new communications systems such as international TV circuits, machine translation of foreign languages, electronically controlled trucks and automobiles, automated libraries, equipment which will type as you dictate, televisionfone (a wrist telephone combining both sound and sight), electric stock market speculation, and robot retailing.

Weiss enthusiastically predicts the the resulting outgrowth of an exciting new future for industry, an era of scientific automated marketing.

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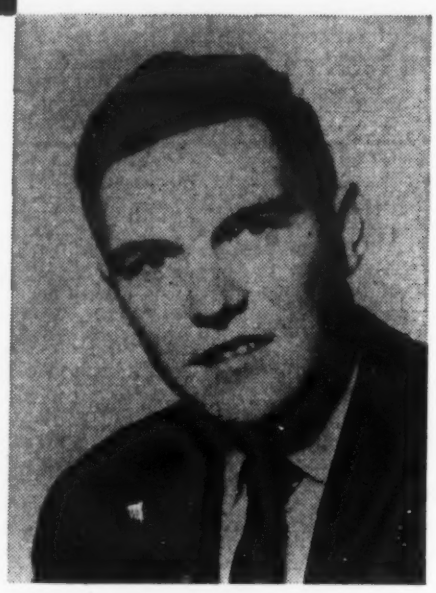

DUDLEY A. BUCK, recipient of the **IRE Browder J. Thompson Memorial Prize Award, 1957** . . . for a manuscript by an author under 30 years of age which is the best combination of technical contribution and presentation of the subject.

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IRE congratulates *Dudley A. Buck* for helping government and American business keep ahead of its work load. His paper entitled "The Cryotron—A Superconductive Computer Component," describes a new active circuit element which introduces large scale electronic digital computers that take up only one cubic foot of space. The new and totally different Cryotron can be easily and inexpensively constructed to help solve problems for science, government and business.

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THE PROSPECTS OF NUCLEAR POWER AND TECHNOLOGY, by Gerald Wendt. D. Van Nostrand Co., Inc., Princeton, N. J. 330 pages, $6.00.

This book presents a vital report—international in scope—on the present status of nuclear fission, together with a thoughtful appraisal of the future of industry and society in a nuclear age.

Under the heading, "Power," Part I discusses the broad ramifications of "atoms for peace." An overall picture of actual and projected atomic plants, in the U. S. and abroad, is given with consideration of the new problems they introduce in such realms as finance, insurance, and governmental control. Dr. Wendt gives serious attention to the immense economic and social upheaval inevitably to result in the new era.

Part II, entitled "Technology," furnishes the important technological background needed to comprehend a totally new concept of industry. The author details the mineral resources available, the nuclear fuels needed, the new metals and materials used in the construction of nuclear reactors and the design of the various types of reactors. Problems remaining to be solved with regard to fission products are discussed. The author indicates the great potential of the nuclear industries in the generation of power, in transportation and in the manufacture of isotopes and other materials with resulting advances affecting the lives and well-being of every citizen.

THE SIGNAL CORPS: THE TEST, by George Raynor Thompson, Dixie R. Harris, Pauline M. Oakes and Dulany Terrett. Office of The Chief of Military History, Dept. of The Army, Washington, D. C. 621 pages, $4.50.

In the series, *U. S. ARMY IN W. W. II*, this volume is the second of a subseries concerning the history of the Signal Corps in the Technical Services and describes the crucial "Test" put to the Signal Corps during the first 18 months of America's involvement in W. W. II.

How the Signal Corps met the challenges, frustrations and overwhelming demands to develop during that period is the theme of the book.

The extent to which the communications systems tie into the tactical systems caused the Signal Corps to receive the brunt of the first calls for men and equipment. To meet the crisis, an amazing expansion of the communications industry in close partnership with the Signal Corps resulted.

The achievements related do not seem to differ greatly from tasks met by other technical services similarly burgeoned under wartime stresses. However, the authors contend that Signal problems are unique. "The science of electronics recognizes no international boundaries; it is all-pervasive; it keeps bursting the lid."

The desperate race with the enemy to produce electronic weapons and counterweapons provides a fascinating story for electronics experts and laymen alike. Ample illustrations and maps vividly picture the events leading to the Test's successful outcome.

The book ends with an account of the crisis which was brought on by the Signal Corps' belief that electronics must be controlled from the very top echelon of War Department authority.

DESIGNING FOR INDUSTRY, by F. C. Ashford. Philosophical Library, New York. 210 pages, $6.00.

The purpose of this book is to provide an overall reliable picture of the profession of product designing, in a manner of general guidance, rather than detailed instruction.

With the advance of technology and the growth of competition, the role of the designer becomes increasingly important not only to those who aspire to practice but also those whose occupations create a need for an appreciation of the various aspects involved.

The boundaries of mechanics and economics within which the creative artist must work are discussed together with sociological and aesthetic restrictions. Practice and some of the executive aspects are extensively treated.

Together with a certain capacity for variety, the task of keeping alive the human scale no matter through what phase of technology we may pass, is finally entrusted to the designer for industry.

TRANSISTORS HANDBOOK, by William D. Bevitt. Prentice-Hall, Inc., Englewood Cliffs, N. J. 410 pages, $9.00.

For the practicing engineer, the radio-TV serviceman, the experimenter or the radio amateur, this manual offers complete practical information on transistors and their specific applications.

With a minimum of mathematics and no complicated theory of physics, the handbook discusses why transistors make electronic circuits simpler, more efficient and more compact, and shows how they make new circuits possible. For convenient reference, a chart is included which lists 56 types of commercially available transistors along with their number, manufacturer, typical operating characteristics and specific applications.

Instruction is given on how to connect transistors in the 3 basic amplifier circuits, how to build inexpensive test devices and compact receivers, and how to employ transistors in gate circuits.

Scores of circuit diagrams, each with typical values of circuit elements, are provided to serve as examples of good transistor circuit design. 380 illustrations supplement the work and a detailed index is included.

RADIO OPERATOR'S LICENSE Q & A MANUAL, by Milton Kaufman. John F. Rider Publisher, Inc., New York 11, N. Y. 720 pages, $6.60.

Designed as a study aid or reference volume, this new edition provides information in complete accordance with the FCC Study Guide now being used as a basis for radio license examinations.

Having been brought up to date particularly with regard to new operating procedures and new frequencies, questions are renumbered according to the new Study Guide. Answers are given in logical simplified form and are followed by supplementary discussions to provide the reader with maximum background information and thorough explanation of the question.

All 8 Elements, including E. 7 on Aircraft Radiotelegraph and E. 8 on ship Radar Techniques are covered. Subject matter is arranged according to Element to agree with the FCC exam presentation. However, a complete index offers convenient study or reference by subject.

This volume also contains valuable appendices on Small Vessel Direction Finders and Automatic Alarm, claimed to be exclusive with this book.

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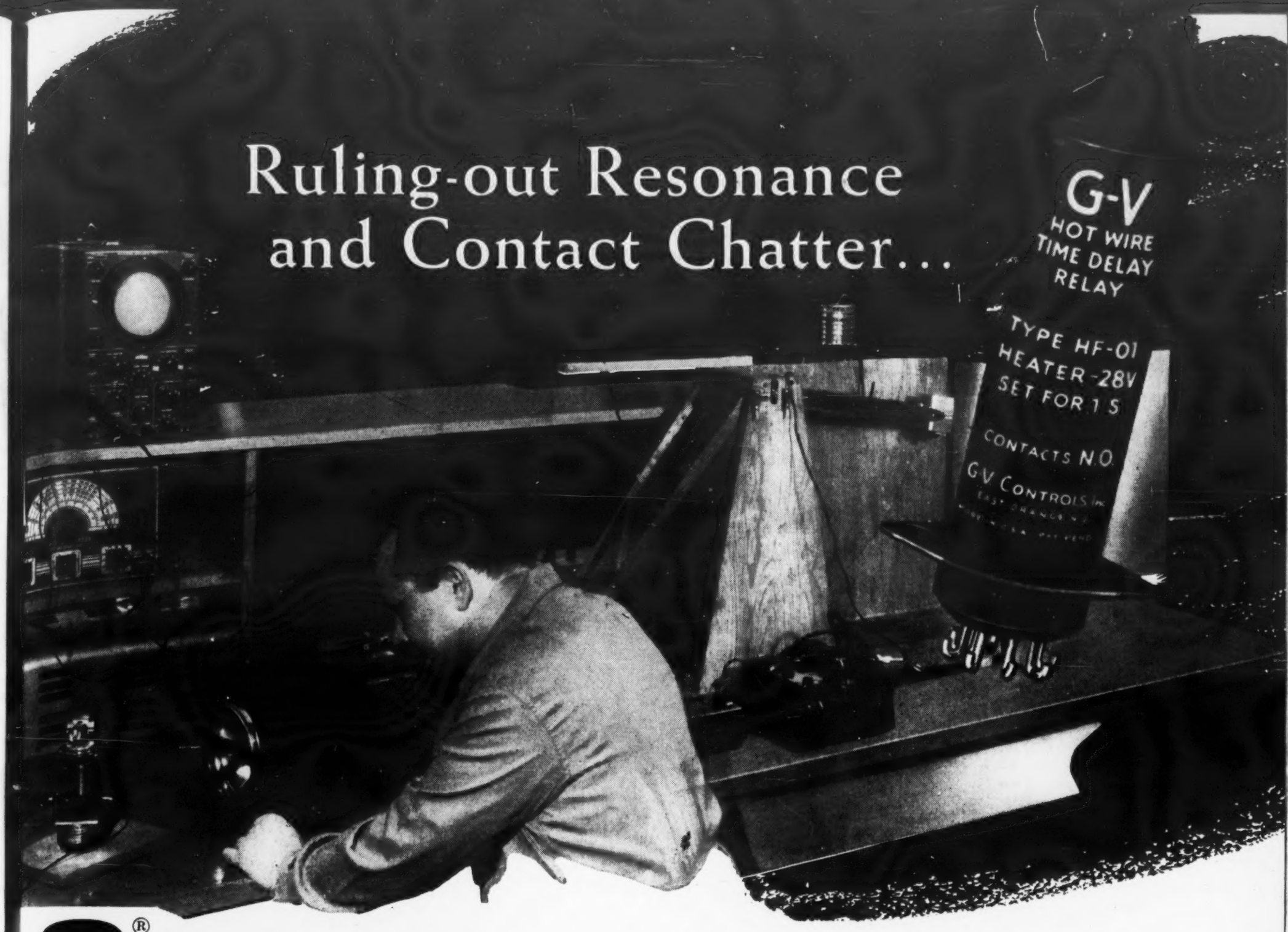

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